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# THE TRANSVERSE POSITION AND THE MECHANISM OF LABOR

## A Historical Collective Review

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IT has become evident to observers employing the precision stereoscope of Moloy for the study of roentgenograms of parturient women, that the transverse positions of the fetal head, namely, LOT and ROT, are the most common variety, not only before, but also after engagement. This is contrary to prevailing obstetrical opinion which regards oblique positions as the most frequent. Since the task of each generation is to interpret past experiences and adapt them to present conditions, an extensive review of the literature on position, obstetrical palpation, normal and abnormal pelves, and the mechanism of labor of transverse and oblique positions, was undertaken. The survival of the earlier opinions and theories on these matters appears to have depended on certain factors such as: father and son relationship; being the pupil of, or an assistant to, an outstanding obstetrician; observations made in various clinics; and by the translation of writings into other languages. Under such influences several schools of thought emerged. These have been summarized by H. F. Naegele in 1838, Schroeder in 1888, Pinard and Varnier in 1892, and Fasbender in 1906. This brief historical resume, together with some of the more recent opinions, is intended to bring the controversy up to the present time.

### THE TRANSVERSE POSITION

It was generally thought from the time of Hippocrates, and for a long time thereafter, that the fetus rested with the buttocks on the false pelvis until term, when it turned so as to present with the vertex. When dystocia developed, Paré (1580), who was a surgeon, employed podalic version, and Chamberlen (1600) applied the forceps. Neither made outstanding contributions on the various positions of the vertex. Adhering to the older concepts, Mauriceau (1668) was of the opinion that the sagittal suture of the fetal head entered the pelvis in the true conjugate, probably because of observations at the time of delivery. His book was translated into English by Chamberlen, so that this conception, illustrated in Fig. 1, was rather widely disseminated. Sir Fielding Ould (1742) was one of the first to contradict the current teaching, stating that the face of the child at the superior strait was always turned to one side or the other. Meanwhile, Levret (1747) supported the views of Mauriceau.

Smellie (1752) showed illustrations of engagement in the transverse diameter in his atlas of the pregnant uterus which are reproduced in Fig. 2. He stated that the sagittal suture was usually directed toward the symphysis. This is one of the first descriptions of posterior parietal presentation, or posterior asynclitism.

Roederer (1762), a student of Levret, arranged a brilliant compromise between the two prevailing opinions by suggesting that engagement occurred in the oblique diameters. Saxtorph (1764) agreed, and believed that engagement occurred in the oblique diameter, probably because of the encroachment of the sacral promontory. Johnson (1769) held similar views, but believed that engagement in the transverse diameter also occurred. Stein, the elder, (1770) supported the theory of engagement in the oblique position of the fetal head and abandoned completely the teachings of Mauriceau.

Solayrés de Renhac (1771) dealt with the mech-

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anism of labor in a systematic way giving the fetal skull six positions at the inlet, designated as from $S_1$ to $S_6$ in Fig. 3. One of his pupils, Baudelocque (1781), followed his teachings but renumbered these positions (See $B_1$ to $B_6$ in Fig. 3.) He regarded positions $B_3$ and $B_6$ as unusual. His writings had many followers because of many translations, including the one by Heath (1807) in this country. Baudelocque published statistics on 10,320 cases as follows:

| | |
|---|---|
| Occiput to the mother's left and anterior | 8,522 cases |
| Occiput to the mother's right and anterior | 1,754 cases |
| Occiput to the mother's left and posterior | 25 cases |
| Occiput to the mother's right and posterior | 19 cases |

As can be seen, the transverse position is not mentioned. However, emphasis was placed on the fact that not a single occipitopubic or occipitosacral position had been encountered. Therefore, Busch (1829) urged the exclusion of OA and OP positions because of their rarity, which brought the number down to 4 as shown with Roman numerals in Fig. 3. These positions have come to be designated in turn as OLA, OLP, (LOA, LOP), etc., in keeping with the recommendations of Simpson's Committee before the International Medical Congress in Washington (1887).

Baudelocque was highly authoritative, but his views did not go entirely unchallenged. Boer (1791) stated that the head established itself either obliquely or transversely except when the pelvis was unusual or the child was small. LaChapelle (1795) supported all positions of Baudelocque except those in the conjugate vera. DeWees (1797) commenced a course of lectures on obstetrics in Philadelphia based on the teachings of Baudelocque. Wigand (1800) declared that there was no fixed rule by which the head entered the pelvis.

In England, as early as 1802, Denman stated that the most common position of the fetal head at the superior strait was the transverse, with deviations in degrees of diagonal direction, as shown in Fig. 4. Denman added that in the passage of the head through the pelvis, various changes occurred in position so that finally the hind-head rotated toward the pubis and the face toward the hollow of the sacrum. This simple, succinct description of the mechanism of labor by Denman was prefaced by the following remark, which probably accounts in part for the many different opinions on the subject.

"A natural labor was the last thing well understood in the practice of midwifery, because scientific men, not formally employed in the management of common labors, had no opportunity of making observations upon them. Practitioners were then engaged in qualifying themselves for the manual exercise of their art, whenever they might be called to give assistance."

Schmitt (1800) agreed with Wigand that the head could enter in the oblique or transverse diameters. Heath (1807) translated Baudelocque's book which supplemented the lectures of DeWees and provided for the dissemination of engagement in the oblique diameters in America. James (1810) gave lectures on obstetrics in America at the University of Pennsylvania based on the textbook of Burns (1809) of Glasgow, who with Mampe (1819) stated that the head entered in the oblique diameter.

F. C. Naegele in 1819 described engagement in the oblique diameter of the pelvis. The Heidelberg professor added that the head reached the interior strait still obliquely placed, and even presented at the vaginal orifice in this position. He also called attention to the fact that the sagittal suture approached the promontory of the sacrum, which produced an anterior parietal presentation, and this has been termed "Naegele's obliquity." Naegele based his contentions largely on vaginal examinations in labor and the caput formation over the right parietal bone (for LOA position), as well as the obliquity of the fetal head due to the uterine axis which was regarded as a line perpendicular to the midpoint of the superior strait. This school of thought is still generally accepted. DeWees (1825), the "American Baudelocque," published his "System of Midwifery" which favored the views of Baudelocque and Naegele. Abroad, H. F. Naegele (1838) supported the views of his father, F. C. Naegele, and also wrote on the history of the mechanism.

Velpeau presented the concept of synclitism in 1835 without naming it. It is essentially a compromise between the anterior and posterior asynclitic presentation of Naegele and Smellie. Synclitism was supported by West (1857), Cazeaux (1853), and Duncan (1861), who added that descent of the head occurred in synclitism. Kuneke (1869) agreed with the latter, stating that synclitism persisted during the entire passage of the head through the birth canal. His theory is illustrated in Fig. 5A taken from the atlas of Pinard and Varnier.

About this time (1864) Hodges entered the controversy, expanding the views of his teachers, DeWees and Baudelocque. He emphasized the laws of mechanics in labor and agreed that the head entered the pelvis in one of the oblique diam-

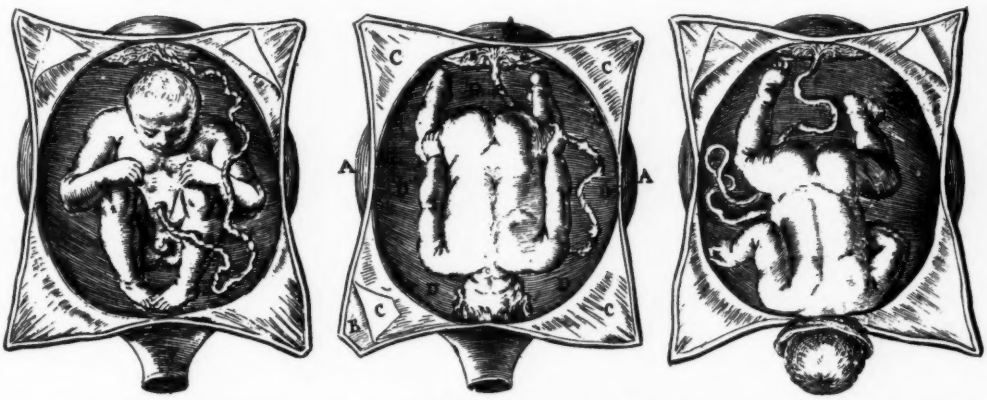


Fig. 1. Breech presentation followed by somersault and engagement and descent of head in the anteroposterior diameter. (From Mauriceau, 1668.)

eters. He cited Baudelocque's classification of position with $B_1$ (see Fig. 3) as the most common position. Hodges explained that when the occiput was at the ileopectineal imminence, the position was regarded as being LOA when the occiput was opposite this point. He permitted sufficient leeway so that all OA, LOA, and LOT positions were called anterior, or the "first position of Baudelocque" as shown in Fig. 3, when the inlet is divided into four quadrants.

Cazeau in 1865 summarized the classifications of Baudelocque, Gardien, Capuron, LaChapelle, Naegele, Velpeau, and Moreau with regard to the position of the head over the inlet, and added his own. His classification, together with that of LaChapelle and Moreau, is among the first to name the transverse position. Cazeau stated that this position was not unusual, and that LOT was more frequent than ROT, and ventured the belief that Baudelocque and the others included it in their right and left anterior or posterior positions (see Fig. 4). Cazeau described the mechanism of labor in conformance with the views of Naegele, with the exception of the obliquity.

About this time, attention was being directed to the classification of pelves and the names of VanDeventer, Stein, Weber, Michaelis, and Litzmann characterize the earlier attempts. Certain writers began to correlate the mechanism of labor with the type of pelvis, although since Paré (1580) this had not been regarded as significant because of the belief that the pelvic bones separated in labor. Hildebrandt emphasized the relationship of pelvic architecture to the mechanism. Duncan (1868) advocated acceptance of engagement in the oblique diameter, but opposed Naegele's obliquity favoring the position of synclitism. Litzmann (1871) reported on the occurrence of posterior parietal presentation when the pelvis was normal or contracted, and that the prognosis was good when the former obtained. Litzmann observed this obliquity in 1.3 per cent of 1,800 cases.

Tarnier and Chantreil (1882) supported Duncan's views and added that when the head reached the inferior strait, asynclitism developed. It is to be recalled that they favored Naegele's obliquity at the inlet. Barnes (1884) made a plea for recognition of Naegele's views. In the same year, Schroeder reviewed the literature extensively and concluded that engagement occurred in synclitism and that Litzmann's obliquity was anomalous. At this time, Lusk (1885), Charles (1887), Werth (1888), and Zweifel (1889) also regarded the posterior parietal presentation as an exception, as did LaChapelle, Moreau, and Pinard. During all this time, no one spoke much of Smellie's ideas on the transverse position and posterior parietal presentation.

The Ninth International Medical Congress met in Washington (1887), and it was unanimously agreed that positions be defined as OLA, OLP, (LOA, LOP), etc.; LOT and ROT positions were not reported on at this conference. Clinical incidences for these positions as generally accepted and published as late as 1935 (Bland) are shown in Fig. 4, the transverse being omitted. In the meantime, Hirst in America (1888) described the mechanism in the oblique diameter following the ideas of Roederer, Baudelocque, Naegele, Cazeau, DeWees, and Hodges before him.

Winckel (1890) stated that before engagement, the head lay in the transverse diameter, poorly

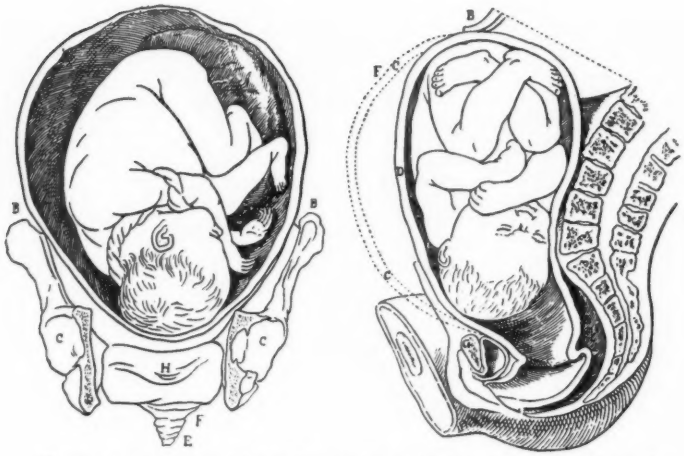

Fig. 2. Transverse position and posterior parietal presentation. (From the Atlas of Smellie, 1752.)

flexed. With engagement, the head flexed and descended in the oblique diameter. With further descent the pelvic floor was reached and the head now moved forward because of additional room anteriorly in the pelvis, and rotation then began. He quoted Spiegelberg to the effect that 81.4 per cent of the heads entered in the transverse diameter of the pelvis.

Meanwhile, further pelvic classifications were proposed, including those by Turner (1885), Schauta (1889), Tarnier and Budin (1898), and Breus and Kolisko (1900). While the type of pelvis received consideration, most pelves were classified on the basis of size. Farabeuf and Varnier (1891) described asynclitism in contracted pelves when the conjugata vera measured 8 cm. They described how a biparietal diameter of 9.5 cm. could pass through as follows: with the head lying transversely in posterior parietal presentation, rotation occurred around the promontory, which brought the anterior parietal bone past the symphysis, and the head dropped to the bottom of the pelvis. This simple, succinct mechanism was not tenable for the normal pelvis, for they contended that while the head lay transversely at the superior strait, engagement took place in the oblique diameter.

In this country, Voorhees (1904) was one of the first to call attention to the transverse position of the occiput.

As late as the year 1912 Williams published the following table in his third edition, which ignored the transverse position (compare with foregoing table of Baudelocque):

| | DuBois (1895) 1,913 cases Per cent | Pinard (1889) 500 cases Per cent | Williams (1912) 1,687 cases Per cent |
|---|---|---|---|
| LOA | 71.0 | 52.0 | 60.9 |
| LOP | 0.6 | 11.0 | 2.6 |
| ROA | 2.8 | 0.2 | 19.7 |
| ROP | 25.6 | 38.8 | 16.8 |

DeLee, in the first edition of his book published in 1913, supported the transverse position of the head, yet described the mechanism of labor in terms of the oblique diameter and Naegele's obliquity, with OLA as the most frequent position. He has adhered to this conception, and in the seventh edition (1939), stated that Caldwell and Moloy had confirmed his views. Historically speaking, the ideas of Winckel, Spiegelberg, Farabeuf and Varnier, Ould, Smellie, Denman, Duncan, Pinard and Varnier, and many others regarding the transverse position and posterior asynclitism before engagement had also been confirmed.

Probably as a result of DeLee's stand, Williams had Plass analyze 5,488 vertex presentations on his service in 1916, and it was found that 21 per cent were transverse! Among these, LOT was more frequent than ROT, as has been our experience with roentgenography. Williams stated in his sixth edition (1926) that many of the patients had been examined late in labor and, therefore, the transverse position was undoubtedly due to a phase in rotation from a primary posterior position. Actually, LOP occurs far less frequently than LOT, as does ROP and ROT, as shown in Fig. 8. The incidence of the transverse positions should approximate that for posterior positions if incomplete rotation is the responsible factor.

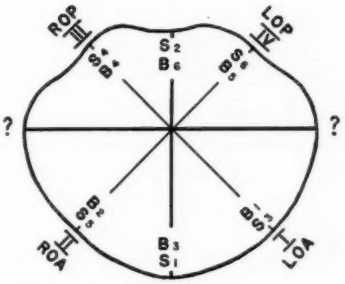


Fig. 3. Showing the positions of the vertex according to: Solayres de Renhac, S1–S6 (1771); Baudelocque, B1–B6 (1781); Busch, I–IV (1829); and Washington Conference, LOA, ROA, etc. (1887).

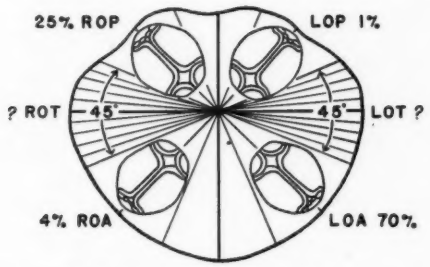


Fig. 4. The incidences of positions of the vertex according to most authorities (after Bland). Compare with Figure 8. Transverse positions are not included. They are regarded as having degrees of diagonal direction within a range of 45 degrees (22.5 degrees on either side of the transverse diameter). This view also holds for oblique and direct OA and OP positions.

Such is not the case, since LOT occurs much more commonly than LOP, whereas ROT has also a higher incidence than ROP. Plass was cautious in urging acceptance of the transverse position *per se* in normal pelves, preferring to wait until it became a generally accepted fact.

Caldwell, Moloy, and D'Esopo (1934) reported that 60 per cent of the cases studied with the x-rays were transverse, with the sagittal suture toward the symphysis (posterior asynclitism). These observations rank in importance with the views of Ould, Smellie, and Pinard and Varnier; they show the transverse position and posterior asynclitism to be the rule and not an exception in normal pelves, contrary to the views of LaChapelle, Moreau, Winckel, Zweifel, Litzmann, Pinard, Farabeuf, Schroeder, and Williams. Stander, in his first revision of Williams' Obstetrics (seventh edition) published in 1935, emphasized the LOT and ROT positions, finding that 5.8 per cent of the positions at the Lying-In Hospital were transverse. However, in the eighth edition (1941), Stander stated that Steele and his coworkers had found that 71 per cent of a series of 200 patients had a transverse position, according to roentgenographic evidence.

### INTERNAL ROTATION

Internal rotation is required in LOT and ROT positions through an arc of 90 degrees in order to bring the occiput under the symphysis. It has also received its share of theoretical consideration. It was first alluded to by Solayres de Renhac in 1771. Boer in 1791 stated that the head turned in the pelvis so that the occiput was brought under the pubis. Denman in 1802 also described rotation. It is ordinarily regarded as occurring through an arc of 45 degrees for anterior positions, although Naegele was of the opinion that the head reached the pelvic floor in one or the other of the oblique diameters and did not rotate completely until delivery, since the caput over the right parietal bone presented frequently at the vaginal introitus. Failure of rotation results in "deep transverse arrest" which often necessitates operative assistance. Such arrests were regarded by Williams as secondary to failure of rotation from posterior positions and not primary *per se*.

However, Smellie, a proponent of engagement in the transverse position, as stated above, mentioned in 1774 that the head changes its position from the transverse to the anteroposterior diameter because of resistance encountered at the ischial spines. Saxtorph agreed with this view, while Baudelocque attributed rotation to resistance of the inclined planes of the pelvis. Hodges (1864) was of the opinion that in posterior positions, a point of the occiput strikes the ischial spines and is reflected anteriorly toward the pubic arch. In 1865, Cazeaux supported the idea of perineal resistance and stated, "When a body free to move is acted upon by two forces, it moves in the direction of neither of these forces, but in the direction of their resultant; which resultant is the diagonal of a parallelogram of which these two forces form two sides." Hirst was in agreement with this view of Cazeaux. DuBois (1895) was of the opinion that resistance of the pelvic floor was responsible, because of his demonstration of rotation in a cadaver. Tarnier stated that the anteroposterior diameter of the fetal head was best adapted to the anteroposterior diameter of the outlet. Farabeuf felt that rotation followed impingement of the head on the symphysis.

To continue, Leishman agreed with Naegele, and in 1887, Veit and Varnier rejected the bony

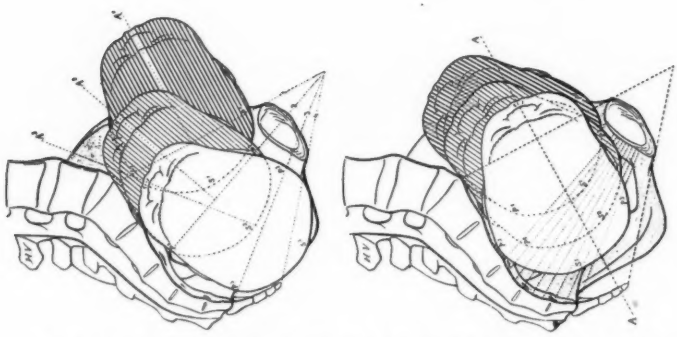

Fig. 5. Mechanism of labor. Compare with Figure 6 a and b. a. Synclitism (after Kuneke). b. Asynclitism (from Pinard and Varnier). (From Pinard and Varnier. Etudes d'Anatomie Obstetricale. Normale et Pathologique. Atlas and Text. Paris, 1892.)

pelvis as insufficient to produce internal rotation, and supported the views of Cazeaux regarding resistance of the pelvic floor. This concept was also acceptable to Williams. The views of Bumm, Sellheim, Olshausen, and others have been well summarized by Paramore in 1909. Since then, DeSnoo and others have made further observations.

### OBSTETRICAL PALPATION

Prior to 200 years ago when debate on these questions began, obstetrical palpation was a little known procedure. Roederer first pointed out its advantages in 1752. Wigand (1812), Hohl (1834), and Crede (1852) practiced the procedure. Baudelocque and Naegele used it, and their opinions influenced James (1810), DeWees (1825), and Hodges (1864) in America. The latter stated that the position was LOA when the occiput was opposite the left ileopectineal imminence. Skiagrams have revealed that the head usually lies transversely over the inlet in Litzmann's obliquity, as shown in Fig. 7, in LOT position. It can be readily seen that the occiput and left parietal area lie over the ileopectineal imminence and that the right parietal protuberance is palpable and can be mistaken for the occiput, and an erroneous diagnosis be made of LOA. This error can be avoided by feeling both the occiput and the frontal prominence at about the same level over the pelvic brim, as shown in Fig. 7.

Earlier users of obstetrical palpation had no check on their clinical diagnoses, i.e., the roentgenogram, and depended upon vaginal examination. This was impractical for the diagnosis of position of the vertex above the brim, and was of value only when the cervix was dilated sufficiently to permit digital palpation. At such a time the mechanism of labor was often advanced or near completion, with the movement of internal rotation in progress. If an LOA position was found at this time, it was natural to assume that the head had engaged in such a position, when actually the head may have engaged in the transverse diameter. Such misinterpretation of data that was otherwise accurate produced misconceptions.

In France, Stoltz, Velpeau, and Devilliers practiced obstetrical palpation, and Cazeaux wrote upon the subject in 1865 and described maneuvers for the transverse position stating that they were similar to those for anterior positions. Lenoir, and See and Tarnier published an atlas in 1871 showing the transverse position, and DePaul (1872) described auscultation as an aid to diagnosis. Thereafter, Pinard published his monograph in 1878, and Farabeuf and Varnier practiced the art in 1891. In 1894, Leopold and Sporlin described the classical maneuvers for obstetrical palpation in vertex, breech, and posterior positions, but not for the transverse. Ribemont-Dessaignes and Lepage in 1896 also described obstetrical palpation.

In the meantime, a few Americans had studied abroad and returned to write upon the subject, including Richardson in 1871, Chadwick in 1872, and Munde in 1879, while Hirst in 1888 barely touched on abdominal palpation. The American Textbook in 1902 described and illustrated the procedure for right and left anterior and posterior positions of the vertex, ignoring the transverse, as did Williams from 1903 to 1930. These writers paid little attention to palpation for the transverse position even though LaChapelle, Moreau, Cazeaux, and Winckel had done so earlier in the foreign literature. Pinard (1878) had stated that

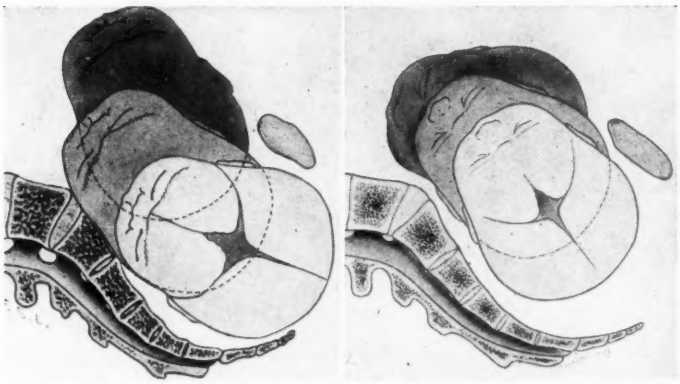

Fig. 6. Mechanism of labor. Compare with Figure 5 a and b. a. Synclitism (after Ahlfeld). b. Asynclitism (from Caldwell and Moloy). (From Stander, Williams Obstetrics. 8th ed. Appleton-Century & Company, 1941.)

this position was to be found only when the uterus was angulated forward as in a pendulous abdomen, or when the pelvis was rachitic, which opinion he changed as will be related. Ribemont-Dessaignes and Lepage (1895) also described the maneuvers for the transverse position, but stated that it was most common when the pelvis was rachitic or the uterus anteverted, which echoed the earlier views of Pinard. They published figures showing that 11 per cent of their patients had transverse positions. Farabeuf and Varnier believed that the transverse position existed before engagement, but that descent occurred in the oblique diameters. Despite the numerous views held regarding preliminary transverse position *per se* prior to engagement, maneuvers as well as the mechanism of labor were invariably described for LOA, ROA, LOP and ROP, since these positions were thought to be the most frequent. Stander (1935) was one of the first to record maneuvers for the clinical recognition of the transverse position in this country.

### STUDIES OF THE MECHANISM WITH FROZEN SECTIONS

Braune (1872) made anatomical studies of the frozen cadavers of women dying in childbirth. This was one of the earliest applications of pathology to obstetrics which had been developed in the previous century.

In 1892 Pinard and Varnier, pupils of Farabeuf, stated that the description of the mechanism given for a contracted inlet also applied to the normal pelvis, thereby challenging authoritative opinions and contradicting their earlier conceptions. They reviewed the literature and attempted to correlate and interpret the various opinions on the mechanism as to their interrelationship. They collected the various clinical impressions that prevailed and compared this information with anatomical evidence derived from a few carefully selected frozen sections of women dying in various stages of labor. They evolved an excellent concept of the mechanism of labor, which to them was based on evidence "as firm as the ground." It was contrary to the classical teachings of that period.

Pinard and Varnier accepted engagement in the transverse diameter and evolved a feasible conception of the entire mechanism of labor from this position. They concluded that the posterior parietal bone presented with the sagittal suture toward the symphysis in "l'asynclitism superior." With labor, the head turned so that the sagittal suture momentarily approached the axis of the superior strait (synclitism). The anterior parietal bone now presented and descent occurred following the curve of Barnes through the inferior strait in "l'asynclitism inferior." Rotation was thought to be initiated because of resistance encountered by the anterior parietal area of the fetal skull at the pubic arch. In addition to their own frozen sections, they studied those prepared by Zweifel and Braune, Winters, and Barbour and found additional support for their contention. All of these frozen sections show the child in the transverse position at the end of pregnancy and also in the various stages of labor, the condition changing from posterior asynclitism superior to synclitism, followed by anterior asynclitism inferior and finally rotation. This concept of the mechanism is summarized in Figure 5B. Unfortunately, it was published in a large atlas which was not widely

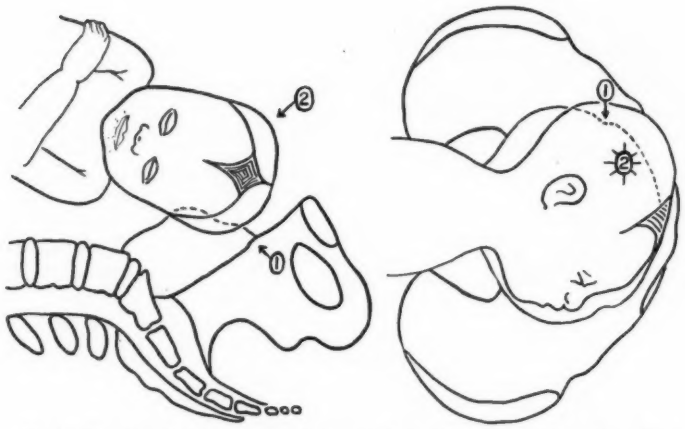


Fig. 7. Showing that in LOT position, posterior parietal presentation, the occiput lies over the ileopectineal eminence (1); the right parietal prominence (2) can be mistaken for the occiput and the position called LOA.

circulated, so that it did not become generally known.

In 1894, Ahlfeld discussed the mechanism from the standpoint of Naegele's obliquity and engagement in the transverse diameter. He used the illustration shown in Figure 6A modified from Pinard and Varnier (see Fig. 5A). This illustration is usually credited to Ahlfeld, when in reality it is an illustration employed by Pinard and Varnier to describe the views of Duncan and Kuneke, with which Ahlfeld was not entirely in accord. Ribemont-Dessaignes (1896) was among the first to support the mechanism as stated by Pinard and Varnier. Thereafter, contradictory opinions were offered by many, including Williams and DeLee, who favored the older concepts of Saxtorph, Baudelocque, Naegele, DuBois, Cazeaux, Hodges, Barnes, and Ahlfeld, despite the fact that the more recent pathological atlas of Canton and Gonzales (1910–1916) showed numerous illustrations of the transverse position. It was not until 1934, when Caldwell, Moloy, and D'Esopo presented their roentgenographic studies on the transverse position and the posterior parietal presentation, that the oblique position was again challenged.

### STUDIES OF THE MECHANISM *IN VIVO* EMPLOYING ROENTGENOGRAPHY

The twentieth century is characterized by outstanding technological developments. Roentgen's discovery of the x-rays (1895) and Potter's invention of the moveable grid (1921) have paved the way for accurate evaluation of the pelvis in obstetrics. They have also provided a means for the study of position as well as of the mechanism of labor *in vivo*. These facts are often lost sight of by those who employ certain limited x-ray techniques.

Several methods have been developed for roentgenographic examinations in obstetrics since Budin in 1897 outlined the superior strait of a deformed pelvis, and Varnier attempted pelvimetry in the same year. Fabre introduced a method for measuring diameters of the superior strait in 1900. In this country, Thoms outlined the superior strait in 1922. Warnekros (1925) made an extensive study of the fetal position and presentation in utero with the roentgen rays. Thereafter, Ball, Hirsch, Johnson, Moore, Clifford, Hodges and Dipple, and others devised methods for evaluation of cephalopelvic size relationships. They included comparative, teleoroentgenographic, frame, triangulation, and stereoroentgenographic techniques. Hooton and Rowden (1931) in England also studied maternal and fetal measurements with their methods. Most roentgenographic methods feature linear measurement of the various maternal and fetal diameters (pelvimetry and cephalometry) and endeavor to find a mathematical relationship either with distorted rulers, formulas, plotting paper, or calculators. Until recently, Thoms employed an isometric centimeter grid technique for the inlet and an isometric lateral view for the anteroposterior diameters of the birth canal. Caldwell, Moloy, and D'Esopo (1934) feature the precision stereoscope. Their method permits a comprehensive visual evaluation of pelvic architecture and cephalopelvic relationship at the

brim, midpelvis, and outlet, and a study of position of the vertex as well as of the mechanism of labor. Hodges and Dipple (1940) concluded that an ideal method of roentgenographic study should include a single isometric lateral film and stereoscopic frontal films. Actually, this represents a *combined* technique and has been employed by Steele and Javert since 1938, as reported elsewhere, in which the lateral and frontal films are exposed with identical positioning of the patient, so that joint work-up of the films is possible.

Caldwell and Moloy have reported extensively on the transverse position, the mechanism of labor, and the pelvic architecture based on roentgenograms taken *in vivo*. They reported that 60 per cent of all positions were transverse even though the pelvis was normal. From this starting point, they described and illustrated a mechanism of labor shown in Figure 6B. There is a striking similarity between this figure and that of Pinard and Varnier shown as Figure 5B. They also proposed a morphological classification of the pelvis in 1933, based on pelves in Todd's collection. Soon thereafter, Thoms (1935) proposed a pelvic classification based on roentgenographic tracings, which he modified in 1938. Stander (1941) provided a combined etiological and morphological classification. The entire problem of pelvic classification is now under consideration by a committee appointed by the American Gynecological Society (1942).

Steele and Javert (1942) found the incidence of the transverse positions in a large series of cases (1,040) to be 63 per cent, as recorded in Figure 8. The transverse position was equally frequent prior to and after engagement of the fetal head. Moreover, Litzmann's obliquity was observed at the brim in 75 per cent; whereas when the head was in the midpelvis, Naegele's obliquity was found in 76 per cent of the cases, which corroborated these opposing opinions. These workers have provided a physiological concept of the mechanism of labor, based on visual perception of roentgenograms in the stereoscope, which has been illustrated in SURGERY, GYNECOLOGY, AND OBSTETRICS for October, 1942. Their work corroborates that of Caldwell and Moloy to a considerable extent. The movements in the mechanism are regarded as the resultants of two forces occurring simultaneously and are well described by the geometrical proposition on the parallelogram of forces given by Cazeaux. Briefly, the mechanism is as follows for LOT position and a normal pelvis:

The head presents over the inlet of the pelvis in LOT position, before engagement, with the sagittal suture lying transversely toward the symphysis and the posterior parietal bone presenting

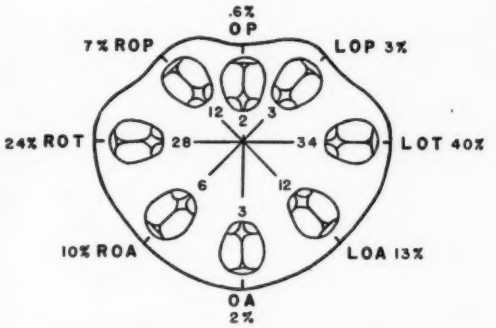


Fig. 8. The incidences of positions at the brim from roentgenograms of 1,040 cases (from Steele and Javert). Numbers within diagram indicate incidences encountered in the midpelvis. Transverse positions have a combined incidence of 64 per cent, whereas the posterior positions have only 10 per cent, which shows that all transverse positions are not due to partial rotation from primary posterior positions as was once contended.

(posterior asynclitism, superior strait). The uterine drive is against the symphysis, with the resultant force backward, wherefore engagement of the head is effected by lateral flexion backward. This is also accompanied by ordinary flexion. The sagittal suture is now in synclitism, and descent occurs to the sacrococcygeal platform (below the spines) so that the anterior parietal bone now presents (anterior asynclitism, midpelvis). Again the uterine drive meets resistance at the sacrococcygeal platform and the resultant force is directed forward, and the head, therefore, flexes laterally again, this time forward. The left posterior parietal bone now impinges on the left ischial spine. This forms a new point of resistance, with another resultant force toward the symphysis which initiates the movement of internal rotation through an arc of 90 degrees; this brings the occiput under the symphysis along the gentle curvature of the ischiopubic ramus, as originally pointed out by Smellie. Disengagement, or extension, and expulsion occur in the anteroposterior diameter of the outlet in the traditional manner. This physiological concept obtained *in vivo* from roentgenograms for transverse positions of the vertex coincides closely with the pathological point of view described by Pinard and Varnier fifty years earlier.

## SUMMARY

It was originally believed that engagement of the sagittal suture of the fetal head occurred in the true conjugate. Later it was suggested that the head engaged in the transverse diameter, while a few believed that there was no fixed rule. Ulti-

mately, a compromise was reached and engagement was thought to occur most frequently in the oblique diameters. This concept has been generally accepted in Europe and was introduced into the New World through teachings at the University of Pennsylvania. Opposing ideas with merit often collapsed because of lack of support from authoritative sources.

Studies of cadavers, and more recently of roentgenograms taken *in vivo*, have shown a high incidence of engagement in the transverse diameter. The failure of obstetrical and vaginal palpation to recognize this fact is probably due to misinterpretation of information that was otherwise accurate; i.e., an original LOT position may have become LOA by the time the cervix was sufficiently dilated to permit digital palpation. Moreover, transverse positions at the brim were probably not recognized because the parietal imminence was mistaken for the occiput.

The frequency of the transverse position both before and after engagement calls for a description of the mechanism of labor with this position as the starting point. The movements of the mechanism depend on parallelograms of forces, and are as follows: transverse position and posterior asynclitism (superior strait), lateral flexion backward, ordinary flexion, engagement and descent in the transverse diameter, anterior asynclitism (midpelvis), lateral flexion forward, internal rotation, disengagement, extension, and expulsion. This physiological interpretation of the mechanism *in vivo* obtained from roentgenograms coincides with that obtained from frozen sections of cadavers.

There are many methods suitable for roentgenographic study of the pregnant woman. Their limitations as well as advantages should be familiar to all obstetricians. A complete method of study should include a diagnosis of the position of the vertex and consider the mechanism of labor, as well as pelvic architecture, pelvimetry, cephalometry, and cephalopelvic size relationships. Mechanisms and positions vary with pelvic morphology; therefore, the interrelationship of all factors can be evaluated only by a comprehensive method of study provided by a combined isometric and stereoscopic technique.

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# THE BACTERIOLOGY OF WAR WOUNDS

## Collective Review

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THE care of large numbers of war wounds occurring in relatively short periods of time has always taxed the ingenuity and resourcefulness of surgeons to the utmost. During war a study of the problems of wound healing necessarily is of the utmost importance. These problems are intimately associated with infection; in fact, infection is the greatest enemy of wound healing. The variations which occur in the site of combat, in the methods of waging war, in the types of wounds produced, and in the available facilities for treatment often present different problems in wound treatment and healing for each conflict.

Observations made in wars, or "traumatic epidemics" as termed by Nicholai Pirogov, have frequently contributed much to a better understanding of these problems, and the majority of ancient and medieval surgeons usually obtained their experience in battle. In the days before Lister, gunshot wounds routinely became infected, and it is interesting to read how helpless Lister and earlier surgeons felt in dealing with putrefactive processes firmly established in a wound. As a result of his military experiences Ambroise Paré revolutionized the treatment of wounds by the abolition of the application of the cautery and burning oil to war wounds and recommended the enlargement of wounds, the removal of bullets, bone splinters, and shreds of cloth. Larrey (54), Surgeon-in-Chief of the French armies under Napoleon, believed that it was advisable to amputate badly injured limbs within the first twenty-four hours. In his experience this procedure afforded a chance of recovery to those unfortunates who must certainly die from the inevitable infection under any other management. This form of treatment converted badly traumatized gunshot wounds into wounds capable of being speedily healed, and obviated the causes of hospital fever and gangrene. He cited how other contemporary surgeons temporized for several or more days before amputating the stumps of limbs shot away by gunshot or bomb fragments, and all of the patients died of gangrene or tetanus. The studies of gas gangrene made by Salleron (97) in the Crimean War and by Frery (27) in the Franco-Prussian War were of considerable importance. Ollier's (77) observations on the occlusive method of treating wounds, similar to that later popularized by Orr (78, 79) and Trueta (103), were also made at that time.

In the later wars conservative treatment became the rule because of the nature of the wounds. In the Boer War in Africa clean "drill-hole" wounds made by bullets were the most common type of wounds, and these usually healed under conservative treatment without serious infection. In the wars immediately preceding the World War of 1914–1918, approximately 80 per cent of the wounds were caused by rifle bullets and only 20 per cent by bomb or shell fragments. In these campaigns conservative treatment was the rule and serious infections such as gas gangrene were infrequently seen.

When this expectant treatment was applied to the management of wounds in the first months of the World War of 1914–1918, the results were appalling. Since approximately 60 per cent of the wounds were produced by highly explosive shells and bombs, the average wound was different from that of preceding wars. Tetanus, gas gangrene, and infections caused by the hemolytic streptococcus were not only frequent but extremely fatal, and surgeons were forced to admit that all war wounds were infected. There were wounds of many sizes and of many tissues, and all were characterized by the most profuse and offensive suppuration. The incidence of tetanus alone in September, 1914, was 9 per 1,000 wounded men according to Bruce (14). The mortality rate of compound fractures of the femur approached 80 per cent, and Frey (28) noted that of the Germans dying in the World War following fracture of the femur, two-thirds died from infection. It soon became evident that the devitalized tissues in war wounds had to be removed to prevent serious infective complications. In the later part of the war the effectiveness of operative cleansing of the wounds was clearly demonstrated. Among the 224,080 men of the American Expeditionary Force who were wounded in France, there were 128,265 with wounds of the soft parts with an incidence of gas gangrene of only 1.08 per cent, and 25,272 with

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wounds including bone fracture with an incidence of gas gangrene of 6.26 per cent (105).

In the Ethiopian and Spanish Wars gas gangrene was relatively infrequent, but with the advent of active fighting in Flanders again in 1939 and 1940, a considerable number of cases were seen.

Mechanization, rapidity of movement, and aerial bombardment have all resulted in more extensive wounds. Burns caused by gasoline, oil, superheated steam, cordite, and the flash of high explosive shells and bombs have become a common type of injury. Bomb blast, blast concussion, and crush injury caused by falling masonry after bombing raids have been frequently described in England.

That surgeons have succeeded in preventing infection in clean operative wounds is one of the great achievements of surgery, but the real problem today as expressed by Reid (90) and Ravdin (87) is the prevention of invasive infection in contaminated wounds. The bacteriology of war wounds is therefore of great current importance and bacterial cultures become a necessary basis for the intelligent treatment of traumatic wounds (84).

## GENERAL CONSIDERATIONS

War wounds are usually more extensive than civil wounds and occur in greater numbers within relatively short periods of time. Kirk (49) tells of more than 2,500 wounded men being received within a twenty-four-hour period at one evacuation hospital. High-explosive wounds seen in modern warfare are more grossly contaminated than the usual civil fresh accidental wound. Because of the intensity of battle and other factors operating in war, many wounds do not reach the surgeon for twelve or more hours, or until the onset of early wound infection, whereas in civil practice it is usually possible to treat wounds in less than six hours. Furthermore, conditions of war are such that men who do the original operations on war wounds seldom are able to make the subsequent dressings (16).

An understanding of the weapons of modern warfare is essential for a proper concept of the nature of war wounds. Projectiles may be roughly divided into three types (5):

1. Bullets from rifle, revolver, and machine gun
2. Shells from artillery and trench mortar
3. Bombs and grenades

During the war of 1914–1918 the different projectiles which caused the casualties were: bullets, 39.61 per cent; shells, 58.21 per cent; and bombs and grenades, 2.18 per cent. During the American Civil War only 10 per cent of the casualties among federal troops were caused by artillery, and 90 per cent were due to small arms. Although statistics are not available for the present war, there undoubtedly will be an enormous increase in the percentage of wounds produced by bombs because of the high development of aerial warfare.

Modern bullets are more pointed and therefore encounter less resistance than former types. The range of the latest German rifles is from one and seven-eighths to over two and one-fourth miles. The missiles have a muzzle velocity of 2,800 feet per second which decreases to 1,100 feet per second beyond 600 yards. In the first 600 yards of projection, the bullet has a definite wobble in addition to the rotary motion, and any wound inflicted within 600 yards may show an explosive effect. After this distance the wobble disappears and the bullet drills a clean hole through soft tissues.

Shells have a thick iron casing which is necessary to withstand the impact of firing. When a shell bursts, irregular fragments of the casing produce very serious wounds which cause great destruction of the tissues and gross contamination. Since aerial bombs are carried over their objectives and then released from the airplane, they require only a very thin casing and permit a maximum charge of high explosive. Consequently, these bombs burst into countless small irregular fragments which are said to have the tremendous velocity of 4,000 feet per second (5) for relatively short distances.

Disruption is the immediate change in wounded tissues, and its amount depends upon the velocity of the missile. The muscle bundles are forced apart and deprived of their blood supply. The wounded muscle assumes the appearance of butcher's meat, does not bleed when cut nor contract when stimulated. Such tissues furnish excellent media for bacterial growth and particularly anaerobic infection. An edema, reactionary to trauma, soon follows and produces tension beneath the deep fascia which further embarrasses the local circulation and favors the development of infection.

## THE BACTERIAL FLORA OF WOUNDS

Recent wars have crystallized interest in the bacterial flora of traumatic wounds. The literature on this subject accumulated from the first World War was enormous. Although many of these studies were not entirely satisfactory because of the limited methods of cultivation and the practice of obtaining material for culture from fresh wounds by swabs, they showed the frequen-

cy with which the anaerobic gas-gangrene producing bacteria could be cultivated from war wounds. This method may not give representative specimens, but, as pointed out by Rathcke (86), Pulaski, Meleney, and Spaeth (84), and others, the cultivation of all tissue débrided from a wound gives more complete and accurate results. It is to be emphasized that inoculation of the tissue is to be done immediately, otherwise nonsporulating anaerobic bacteria will often be missed.

The first World War reports on the bacterial flora contributed much to our knowledge. As the result of intensive studies by such men as Fleming, Wright, Henry, Weinberg, and Seguin, and others, certain fundamental concepts developed. Wounds received in combat were grossly contaminated and all became infected if untreated. The organisms found in wounds were roughly divided into three groups:

1. Sporebearing microbes of fecal origin
2. Nonsporulating microbes of fecal origin
3. Pyogenic cocci

The first group consisted chiefly of the anaerobic gas-producing bacteria such as clostridium tetani and welchii, vibrion septique, and clostridium oedematiens, histolyticus, sporogenes, fallax, and tertius.

The nonsporulating bacteria of fecal origin included the enterococci, the bacillus proteus, coli, and aerogenes, and other members of the colon group.

The third group of pyogenic cocci included the staphylococcus and streptococcus pyogenes. Nearly all war wounds contained these pyogenic cocci at a late stage.

In addition, Fleming (25) recognized three phases in the bacterial flora of war wounds. In the primary stage of infection, which lasted approximately one week, the infected wound contained a dark reddish brown, foul smelling, watery discharge consisting of blood more or less altered by the growth of fecal bacteria. In this stage the sporulating anaerobes and streptococci were most commonly seen. In the secondary phase a gradual transition occurred between the primary anaerobic infection and the infection with pyogenic cocci. During this transition the exudate became purulent and progressively less in amount, and finally disappeared. This state lasted from two to three weeks and was followed by the tertiary phase during which the fecal elements disappeared and a simple pyogenic infection of streptococci persisted.

The original high incidence of sporulating anaerobes and their gradual disappearance from the wound was demonstrated by Fleming (25) by his showing that the clostridium welchii was present in 81 per cent of the war wounds of from one to nine days' duration, in 34 per cent of the war wounds of from eight to twenty days' duration, and in only 18 per cent of the wounds twenty days old. Staphylococci (26) are found in practically all severe wounds at some stage of the infection, being derived from the patient's skin or from some outside source. The coagulase test should be performed with the isolated staphylococcus, since a positive result indicates pathogenicity; if the result is negative, the species is not likely to be of major importance in a wound. According to Fleming the bacillus pyocyaneus, bacillus proteus, and the coliform bacillus are found frequently in all stages of infection, but their pathogenicity is low. Diphtheroid bacilli are present during the later stages but they are seldom of importance.

Not only did the bacterial flora undergo changes in the individual case, but it was also mixed, consisting usually of two or more bacteria in any of the stages. No appreciable difference was noticeable in the bacterial flora of wounds with clinical gas gangrene and of those without. The onset of gas-bacillus infection appeared to be due not so much to the nature of the infection, but to the nature or mechanical condition of the wound.

### WOUND CONTAMINATION

When micro-organisms are carried into fresh open wounds, a variable period of contamination exists until active infection occurs. During this period of primary contamination the bacteria multiply in the devitalized and injured tissues, but absorption of toxins is minimal and invasion of the lymphatics surrounding the wound has not yet occurred (7, 40).

The time interval that separates a contaminated from an infected wound actually represents the period of incubation for the organism or group of organisms present in that wound. The time necessarily varies with the virulence and rate of growth of the bacteria, but usually it lasts from six to eight hours with an outside limit of twelve hours. It is also dependent upon other factors, such as the location and nature of the wound, the general condition of the patient, and the presence of systemic diseases, particularly diabetes. Relatively few bacteria will be seen early in a stained smear of the secretions of a freshly contaminated wound. Lockwood (58) and Poate (82) have pointed out that great advantage may be taken of the period of primary contamination by the institution of sulfonamide chemotherapy in a wounded individual at the earliest possible moment to keep bacterial multiplication at a minimum. In such

a manner it is probable that the period of contamination will be greatly lengthened. If a war wound has not received treatment for eight or more hours after its inception, particularly if it is grossly soiled, it may be considered infected. As infection follows contamination, bacteria extend beyond the wound edge, invasion of the lymphatics occurs, toxins become absorbed, and the patient is ill.

There is still considerable difference of opinion regarding the question of whether or not all accidental or war wounds are contaminated by bacteria. Many reports indicate that negative cultures may be found in from 7 to 41 per cent of fresh accidental wounds. Veraart and Drenth (107) found that 41 per cent of the wounds they studied were sterile, Dimtza and Gutscher (23) 21.7 per cent, Levaditi (55) 7 per cent, Miles *et al.* (69) 9 per cent, and Hare (35, 36) 11.1 per cent. An analysis of these studies shows that in the majority of instances, the specimens cultured were obtained from swabs and not from débrided tissue. On the other hand, the reports of Sas (98) and Pulaski, Meleney, and Spaeth (84) indicate that all accidental wounds are contaminated. In a recent series of 99 extensive fresh accidental wounds studied at the Cincinnati General Hospital by Altemeier (2), only 4 negative cultures were obtained from débrided tissue. It is interesting to note that all of these negative cultures were made early in the study, and it is believed that a false result was obtained in at least 2 of these because of an incubator which became too hot. Although no viable growth was obtained, stained smears of the incubated culture media showed bacteria. For this reason Altemeier also believes that probably all accidental wounds, particularly extensive ones, are contaminated with bacteria. Observations made in the first World War that all untreated war wounds became infected lends some support to this belief.

In recent years there has been great interest in the bacteriology of wounds, and numerous reports have come from England, France, and America. During the period of contamination the bacterial flora has been found to be essentially the same as that of the first World War wounds.

Sas (98) in 1930 studied 55 fresh accidental wounds and found the staphylococcus albus in 41.8 per cent, the staphylococcus aureus in 20 per cent, and gas-producing anaerobes in 20 per cent. Other organisms isolated included the bacillus coli, the staphylococcus citreus, the pneumococcus, and various saprophytic bacteria.

Dimtza and Gutscher (23) in 1933 cultured the tissue débrided from 424 wounds and found the staphylococcus in 168; the staphylococcus, streptococcus, and bacillus coli in 59, the streptococcus alone in 31, and the clostridium welchii in 57.

In 1939 Levaditi, Gerard-Moissonnier, Brechot, and Tournay (56) studied cultures made of the secretions from 68 wounds. The majority of the wounds were contaminated with 3 or less bacterial species, although in some instances, 4, 5, or 6 species were present. The staphylococcus was isolated from 85 per cent of the cases, the streptococcus from 58 per cent, the bacillus coli from 41 per cent, the enterococcus from 28 per cent, and the clostridium welchii from 17 per cent. Other bacteria included the bacillus pyocyaneus, bacillus proteus, bacillus subtilis, and sarcina. Later (1940) these same authors (57) studied 31 war wounds seen a fortnight after injury and infected with streptococci. The facultative anaerobic streptococcus pyogenes hemolyticus was the type most frequently found. The mouse virulence of these strains was low.

Levaditi (55) reported the results of 317 cultures of war wounds. Nineteen per cent contained 1 bacterial species, 32 per cent contained 3 species, 19 per cent contained 4 species, and 23 per cent contained 5 or 6 species. The bacteria most frequently found were the staphylococcus (85 per cent), Friedlander's bacillus, clostridium welchii, streptococcus, coliform bacillus, and bacillus pyocyaneus.

In the Spanish War the rush and urgency of hospital work and the lack of suitable apparatus unfortunately hindered the bacteriological study of war wounds. However, Moragas, Pellicer, Folch, and Orial (102) made some studies of the discharges from wounds treated by the Trueta-Orr method. They found a great diversity of bacteria was always present including various types of the streptococcus, staphylococcus, bacillus pyocyaneus, Gram-negative coccus and bacillus, and in 1 instance the clostridium welchii. This diversity of bacterial types was found at each change of plaster, but the bacillus pyocyaneus became more and more in evidence as the wound healed. Despite the presence of numerous bacteria, healing progressed uninterruptedly.

In a very careful study of the aerobic and anaerobic bacterial flora of 200 fresh traumatic wounds, Pulaski, Meleney, and Spaeth (84) found aerobic bacteria only in 66.5 per cent, anaerobic only in 1.5 per cent and both in 32 per cent. The percentage of anaerobes increased with the duration of the wound before treatment. The staphylococcus was the most frequently isolated bacterium recovered from nearly every wound. Next in frequency was the streptococcus which was isolated

in 105 instances from 50 per cent of the wounds. The nonhemolytic variety accounted for 53 of this number, 40 being aerobic and 13 anaerobic. The hemolytic variety was isolated from 34 cases, 25 being aerobic and 9 microaerophilous. Green streptococci were cultured 18 times. Clostridial organisms were recovered from 46, or 23 per cent, of the cases and included the clostridium welchii in 24 instances, the clostridium novyi in 2 instances, the clostridium tetani in 3 instances, and the clostridium histolyticum in 2 instances. Other sporulating gas-producing anaerobes recovered were the clostridia sporogenes, tertium, chauvei, multifermentans, bifermentans, botulini, and aerofaetidum. With this group of anaerobic organisms the staphylococcus albus was associated 39 times, the staphylococcus aureus 22 times, and the streptococcus 24 times. No case of gas gangrene developed in this series. Enterobacilli, such as the bacillus coli, bacillus proteus, eberthella, shigella, bacillus alkaligenes, bacillus pyocyaneus, Friedlander's bacillus, and bacillus prodigiosis, were present in 49, or 24.5 per cent, of the cases. Bacteria were rarely found in pure culture and an average of 3 different species was isolated from each wound.

Rathcke (86) cultured tissue excised from 140 fresh wounds and found the staphylococcus in 109 cases, the streptococcus in 28, the bacillus coli in 7, the clostridium tetani in 6, and other clostridia in 21.

Miles *et al.* (69) studied the bacterial flora of 49 recently acquired London air-raid casualties and 105 military casualties evacuated from northern France by way of Dunkirk. Cultures were taken by means of swabs, and the most commonly found bacteria and their incidence were: staphylococcus aureus 53.3 per cent, hemolytic streptococcus 25.3 per cent, staphylococcus albus 25.4 per cent, coliform bacterium 20 per cent, clostridium welchii 16 per cent, aerobic spore-forming bacillus 14.5 per cent, viridans or nonhemolytic streptococcus 13.9 per cent, diphtheroid 10.8 per cent, and clostridium sporogenes, bacillus proteus, bacillus pyocyaneus, and other clostridia each from 6 to 8 per cent.

Hare (35) investigated cultures obtained by swabbing 355 fresh accidental wounds obtained from the emergency wards and the first-aid stations of two industrial plants. The method of isolation did not include media or methods suitable for the growth of strict anaerobes. Staphylococci were found in 253 instances, alpha hemolytic streptococci in 55, coliform bacilli in 13, and hemolytic streptococci in 2. In addition, Hare believes that the hemolytic streptococci belonging to Group A are the most frequent cause of wound sepsis. Although hemolytic streptococci can often be cultivated from wounds, they are not infrequently of little pathogenicity.

In war burns Wakeley (108) found the hemolytic streptococcus to be the most common infecting agent, but mixed infections were only too likely to occur.

Of the pyogenic infective agents of war wounds Cruikshank (19) considered the streptococcus pyogenes to be the most important and the staphylococcus next. He believed the coagulase test to be a significant test for staphylococcal pathogenicity. This test depends upon the ability of the staphylococcus to coagulate human or rabbit plasma when incubated for from three to six hours at 37° C. In his opinion the bacillus proteus and bacillus pyocyaneus possess no invasive powers but are of nuisance value. The responsible bacteria of gas gangrene are the clostridium welchii found in from 70 to 80 per cent of the cases in the last war, vibrion septique found in from 10 to 15 per cent, and the colstridium oedematiens found in from 5 to 35 per cent. He considered the clostridium welchii and clostridium oedematiens to be more toxigenic than invasive, and the vibrion septique to be both invasive and toxigenic.

Spooner (99) examined pieces of external wounds, wound tracts, and foreign bodies from 31 early air-raid wounds. Pyogenic cocci were less frequent and coagulase negative staphylococci, aerobic spore-bearing bacilli, and clostridium welchii were more common in recent than in older wounds. Other bacteria isolated included the bacillus coli, diphtheroid bacillus, the nonhemolytic and the green-producing streptococci, micrococci, and other clostridial forms.

During the year 1941 and the first part of 1942 Altemeier (2) investigated the bacterial flora of 99 fresh accidental wounds by culturing all débrided tissue. The wounds studied were principally extensive lacerations and compound fractures. The staphylococcus was isolated from 86 per cent of the wounds, the streptococcus from 54 per cent, the clostridium welchii from 39 per cent, the enterobacillus from 20 per cent, the bacteroid from 11 per cent, the anaerobic streptococcus from 8 per cent, and other clostridial forms from 6 per cent. Of the 101 strains of staphylococci isolated from the 86 cases, 37 were hemolytic and 64 were nonhemolytic. Thirteen strains of the aerobic streptococci were hemolytic. The incidence of clostridium welchii contamination in 39 of the cases is higher than that in the recent series of Pulaski, Meleney, and Spaeth (11.9 per cent),

Levaditi (17 per cent), Dimtza and Gutscher (20 per cent) and Sas (14.5 per cent). However, over three-fourths of the 99 wounds studied were extensive, visibly dirty, and three or more hours old. Each of these factors is known to increase the incidence of clostridial contamination. Four cases of clinical gas gangrene developed in the series, and all occurred in the group of 39 cases originally found to be contaminated by the clostridium welchii. As part of the same study, the bacterial flora of 13 burns was also investigated by careful collection and culture of all the débrided skin. Gross bacterial contamination of the burned surfaces by a large number and variety of bacteria was found; the bacteria included the staphylococcus, streptococcus, clostridium welchii, coliform bacilli, and other clostridia. The high incidence of clostridium welchii, in 85 per cent of the cases, was particularly interesting and entirely unexpected. In a discussion of this with Meleney, it was learned that he had made similar observations on burns. The results of such burn cultures indicate the necessity for thorough débridement followed by cleansing of the burned area with soap, water, and saline solution before local burn therapy is instituted.

A review of the existing recent literature on the bacterial flora of accidental or war wounds shows several significant facts. All war wounds, and in all probability all accidental wounds, are contaminated by bacteria by the time they are seen by the surgeon. The types of bacteria contaminating wounds may be divided roughly into two groups: (1) those originally of fecal origin, such as the anaerobic clostridial organisms including the clostridia welchii and tetani, enterobacilli including bacilli coli, proteus, pyocyaneus, and aerogenes, and enterococci; and (2) those of pyogenic origin such as the staphylococci, streptococci, and the microaerophilic and anaerobic streptococci.

There is uniform agreement that the most serious infections occurring in war wounds are tetanus, gas-gangrene, and pyogenic infections. Cruikshank has recently included a fourth group including wound diphtheria, "Meleney's" ulceration, and infections caused by anaerobic streptococci and anaerobic Gram-negative bacilli. Infections with anaerobes show a high mortality rate but a shorter period of danger to life, unless the anaerobes are in association with a hemolytic streptococcus. Hart (37) noted in the Spanish Civil War that severe anaerobic infection of wounds almost invariably involved bones. Deaths from streptococcal infections were numerous and occurred at least up to the end of the fourth month. Zeissler (111) recognized tetanus, gas gangrene, and malignant edema which frequently occur as a mixed infection produced by such causal bacteria as the clostridia welchii and novyi, vibrion septique, and the clostridia histolyticus, sporogenes, and chauvei.

The bacterial flora of infected war wounds is known to vary with the age of the wound. During the first week the chief bacteria involved are (1) the spore-bearing anaerobes including the clostridium welchii, vibrion septique, and the clostridia oedematiens, fallax, histolyticus, sordelli, tetani, sporogenes, and tertius; and (2) the aerobes such as the bacillus proteus, coliform bacillus, enterococcus, staphylococcus, and streptococcus. At this stage the hemolytic streptococcus is relatively uncommon. Clostridial organisms play the most important part of primary infection of war wounds. In general their pathogenicity is low until placed in a wound containing devitalized tissue. During the primary stage of infection of severe wounds the discharge is characteristically a dark reddish-brown fluid, frequently foul-smelling, and containing few pus cells, but masses of bacteria. It is during this stage that gas gangrene and tetanus are prone to develop. The primary anaerobic infection disappears at variable rates in different wounds, the rate depending upon the severity of the wounds and the presence of sloughs or sequestra. The infection is gradually replaced, often during the second week, by the stage of secondary infection, which includes principally the pyogenic cocci, the bacilli pyocyaneus and proteus, coliform bacteria, and other micro-organisms.

### SOURCES OF BACTERIA

*Primary infection.* The most important sources of bacteria are soil, clothing, skin, or hair, and various other foreign bodies including wood, metal, or stone splinters. The great number and wide variety of bacteria of fecal origin in soil, particularly when it has been highly fertilized and cultivated, is well known. Zeissler (111) in 1940 stated that not only are the causal organisms of gas gangrene known, but also their incidence in the soils of different battlefields is established. According to Wan (110) the number of clostridium welchii spores in cultivated and polluted soils sometimes reaches 10,000 per gram of soil. Soldiers live in constant intimacy with the earth, and therefore their uniforms during combat are commonly soiled with it. Pieces of clothing carried into a wound are thus a potent source of contamination. In the first World War, Fleming examined portions of uniforms of wounded soldiers returning from Flanders, and found the

clostridium welchii in 83 per cent, the clostridium tetani in 33 per cent, the streptococcus in 41 per cent, and the staphylococcus in 17 per cent. Until recently it was believed that the presence of gas-gangrene bacteria on the clothing and skin of a soldier always depended upon the bacterial flora of the geographical area in which he was fighting. Gage (29) and Maes (59) believe there is an additional explanation for bacterial contamination of wounds by clothing. All domestic animals, including sheep, harbor anaerobic organisms and clothing made from wool is routinely and naturally contaminated by the clostridium welchii or other gas-producing bacteria. Pieces of woolen cloth obtained from manufacturers' sample catalogues were cut in half. One half of each original piece was cultured and gas-forming anaerobes were recovered from more than 90 per cent of the specimens. After dry-cleaning and steam-pressing of the remaining pieces, similar results were obtained. Cultures of cotton-cloth samples did not show the presence of the clostridium welchii or other bacteria of the gas-gangrene group. Recently, at the Cincinnati General Hospital, Altemeier (2) cultured 25 pieces of woolen cloth 2 in. in length by ½ in. in width and isolated the clostridium welchii from 23, an incidence of 92 per cent.

It has long been established that gas gangrene occurs more frequently during cold weather than in dry warm weather. This seasonal incidence of gas gangrene is in keeping with the observation of natural contamination of wool clothing, since woolen clothing is used during the winter months. During the summer months, when cotton clothing was worn in New Orleans, Maes (59) noted a very low incidence of gas gangrene, but in cold weather when woolen clothing was used, the incidence was greater. In the Italo-Ethiopian War when cotton clothing was worn, it is reported that there were no cases of gas gangrene (6). Wall (109) noted that comparatively little gas gangrene was encountered in wounds inflicted upon the soil of the Yangtze delta upon which Shanghai stands, notwithstanding the fact that there is probably no more heavily manured soil. Wan (110) reported 17 cases of gas gangrene from the Peking Union Medical College Hospital, and that the clostridium welchii was recovered from every wound.

Bacteria may be carried into the deeper tissues of a wound from the patient's skin or hair. The skin normally has a resident bacterial flora which is composed usually of staphylococci, but occasionally of streptococci (26), coliform bacteria, and anaerobic spore-bearing bacilli (94). According to Hirshfeld (39), if eyebrows or hair are gently agitated over an open petri plate of blood agar, from 2 to 100 colonies of staphylococci result. Gillespie, Devenish, and Cowan (31) found that 19.5 per cent of 159 medical students were skin carriers of virulent strains of staphylococci. Price (83) has shown that when the skin is constantly exposed to certain bacteria many of these may become part of the resident flora. The constant contamination of the skin and clothing by soil and the difficulties in bathing may therefore be important factors in the composition of the bacterial flora of the fighting soldier's skin.

Climate seems to have some influence upon wound infection. In warm moist lands (tropics) Irwin and Pla (41) found that streptococcal infections and diseases known to be caused by streptococci were uncommon, although pyogenic infections were commonly seen. McDill believes that if there is any peculiarity about microbic wound infections in the tropics, it is probably the rareness with which the streptococcus is responsible. Barry noted that streptococci were infrequent in Burma and in Ceylon. Faul found staphylococci more responsible than streptococci for infections in the tropics and that apparently the natives had some natural immunity to streptococci.

*Secondary infection.* The sources of the increasingly important secondary infection of wounds include the respiratory tract of anyone treating or observing the wound, unsterile dressings, the skin of anyone touching the wound, dust of the operating room or hospital ward, and contaminated dressings, instruments, or utensils. There is strong evidence that the discharge of infected wounds, such as burns, open draining wounds, or fecal fistulas, contaminates the clothing, the dressings, and the bedding, and the manipulation of the latter charges the air with bacterial-laden particles of lint, dust, epithelium, or dried exudate.

In wars before the time of Lord Lister, in the first World War, and to some extent in the present war, the spread of the bacillus pyocyaneus through a surgical ward was well known and was easily recognized by the green or greenish-blue discoloration of the dressings. This phenomenon is of great significance since it indicates flaws in surgical technique, for it would be even easier to establish growth of a greater pathogen, such as the hemolytic streptococcus, in such wounds. In a recent Lancet editorial (24) infected war wounds are grouped into (1) extrahospital infections chiefly caused by anaerobes, and (2) intrahospital infections produced principally by hemolytic streptococci and staphylococci and to a lesser extent

by the bacilli coli, proteus, and pyocyaneus. Intrahospital infection has occurred in only 5 per cent of the wounds upon admission to the hospital, in 50 per cent after one week's hospitalization, and in from 70 to 80 per cent later on. The British War Wound Committee (67) emphasizes that hospital infection occurs in peacetime surgery as well, but is naturally more obvious in war.

Miles and others (69) stress the significance of hospital infection or secondary infection of wounds and list its sources as:

1. Patient carriers
2. Personnel carriers (mouth, nose, skin)
3. Wound flora and bacteria from bed clothing
4. Dust
5. Ward baths
6. Dressings
7. Bed pans
8. Hands and fingers
9. Dressing instruments

They advocate more aseptic and antiseptic handling of wounds and the reduction of potential sources of infection in the hospital environment.

Hare (35, 36) and Fleming (26) believe the hemolytic streptococcus is the most important agent in secondary infection. In a few instances this organism may come from the patient's own skin but usually it results from faulty technique of dressing, from droplet infection from an infected or carrier attendant, or from infectious dust or bed clothing. It is of interest to note that Lord Lister laid great stress upon air-borne infections, but until very recently their importance has been underestimated. Fleming emphasizes the fact that the hemolytic streptococcus can remain viable and virulent for a considerable time in dust, and that when blankets are shaken or the floor is swept, these bacteria go into the air and become a potential source of infection. He warns that unless very strict precautions are taken in every hospital ward, cross infections are bound to occur. In the immediate vicinity of an infected wound, culture of the air consistently showed it to be contaminated with hemolytic streptococci (55).

Hemolytic streptococci have been grouped by Lancefield (53), and approximately 90 per cent of the pathogenic strains occur in Group A, whereas Groups B to K are usually nonpathogenic. Hare and Willets (36) concluded from their studies of 350 accidental wounds that (1) the majority of hemolytic streptococcus infections are produced by Group A strains introduced after rather than at the time of injury with the exceptions occurring when the patient is a carrier; (2) this streptococcus is present in the nasopharynx in a high proportion of the infected cases; (3) cross-infections with streptococci may occur in hospitals; and (4) staphylococcal infections may show a similar picture. However, in the case of hemolytic staphylococci, Altemeier (2) found that contamination of fresh wounds with virulent strains of this organism at the Cincinnati General Hospital had already occurred in 35.3 per cent of the cases by the time débridement was performed. Each of these hemolytic strains were also coagulase-positive. These results indicate that hemolytic staphylococcal contamination may reach a considerable proportion of severe and extensive wounds in hospital practice. This bacterium is introduced into the wound possibly at the time of injury from the patient's skin, or more probably at some later time during the administration of first aid, the transportation to the hospital, or the examination and observation in the receiving ward just prior to operation.

The British Medial Research Council recently reported that hospital infection of war wounds was quite prevalent. In many instances the infection was not obvious and was not recognized. Hemolytic streptococci were found to produce the gravest infections, although pathogenic hemolytic streptococci were found to be quite rare by Hare in fresh accidental wounds. On the other hand, Orr-Ewing, Scott, and Gardner (80) warned that there may be considerable delay in the growth of many species of bacteria in wounds débrided within a few hours after injury, and for this reason they suggested that the appearance of a new bacterial species within the first fifteen days may not be ascribed necessarily to hospital infection. Nevertheless, the facts indicated that large percentages of war wounds become contaminated and infected while under treatment in hospital surgical wards and that as many as 70 per cent of the ward cases may be infected at one time. Meleney (68), Devenish and Miles (22), and others investigated the sources of bacterial spread in hospital wards. Briefly, these were the nose, throat, and hands of the personnel treating the wounds, infected wounds, contaminated air of the surgical ward, and various instruments and utensils used in the treatment, such as bandage scissors, cast cutters, and ward baths. All layers of the dressings covering infected wounds, as well as the surrounding skin and the sheets and blankets, were found to be contaminated. It was possible to isolate hemolytic streptococci and staphylococci from the fingers of those touching soiled dressings. The manipulation of bed clothes, dresses, bandages, and plaster casts was an important source of air contamination. The report confirmed previous observations that bacterial contamination of air is mini-

mal in the early morning and greatest during the sweeping of floors, making of beds, and manipulation of dressings. Such observations indicate the necessity of rigid aseptic technique in the application of dressings, including the initial first-aid dressing. McKissock, Wright, and Miles (65) were able to reduce the infection of war wounds from 31.3 per cent to 2.2 per cent after adoption of new dressing technique designed to prevent mechanical transfer of infected material from one wound to another, and contamination of wounds by droplet or air dust. By the application of liquid paraffin to blankets and sheets, the dust produced by their shaking was reduced approximately 90 per cent without making them objectionably oily (106). Blalock (11), Koch (50, 51), and Mason (60, 61) believe that pathogenic organisms from human sources frequently gain entrance into a wound some time after rather than at the time of injury. The application of a sterile dressing only is recommended as first-aid treatment, but touching the wound with unsterile dressings, fingers, or other soiled objects is distinctly discouraged. Thomas (101) produced a significant and prolonged reduction (approximately 80 per cent) in the number of bacteria thrown into the air by sweeping through the use of spindle oil on all ward floors and thereby reduced the danger of infection from pathogenic organisms accumulating in ward dust.

Hare (34) pointed out that the freedom from infection of wounds encased in plaster may not be due to immobilization as generally believed, but that the plaster cast prevents secondary contamination of the wound by hemolytic streptococci of Group A. Spooner (99) found the thick brown inspissated pus of wounds treated by the closed plaster method to be composed almost entirely of bacteria. Of 29 cases studied, 20 showed the presence of hemolytic streptococci, 20 of staphylococci, 19 of diphtheroid bacilli, 7 of proteus bacilli, 8 of pyocyaneus bacilli, and 2 of Welch's clostridia. There was no indication that these bacteria were doing the patients much harm. Orr-Ewing, Scott, and Gardner (80) studied the flora of wounds encased in plaster, and they found that it did not appear to be different from that of open wounds. Cross-infection occurred fairly often during changes of plaster, but was not detected at any other time.

### FACTORS INFLUENCING WOUND INFECTION

The factors which determine the incidence and character of infection include: (1) the virulence, types, and number of contaminating bacteria; (2) the nature, location, and duration of the wound; (3) the presence of foreign bodies; (4) the general condition of the patient; (5) the capacity (58) of immunity response of the individual; and (6) the type and thoroughness of treatment.

The invasiveness of different types of bacteria varies. Hook (40) states that although bacteria multiply in the tissues during the period of contamination, invasion of the adjacent lymphatics does not yet occur. He believes that it is possible for the hemolytic streptococci to pass beyond the wound barriers in less than six hours. The presence of virulent strains of such bacteria as clostridium welchii; vibrion septique; clostridia oedematiens, histolyticus, and tetani; hemolytic streptococci; and hemolytic staphylococci furnishes the agents of wound infection. The degree of soiling or number of contaminating bacteria has long been known to increase the probability and severity of wound infection. In addition the synergistic or cumulative action of the bacteria may determine to a large extent the nature and severity of the infection. It has been observed that the hemolytic streptococcus in association with the clostridium welchii may increase the latter's virulence, and the hemolytic staphylococcus may do so to a lesser extent.

The frequent occurrence of the clostridium welchii in wounds without symptoms of gas gangrene has led to the assumption that many of these strains are nontoxic. Robertson and Keppie (95) investigated this matter with 26 strains of the clostridium welchii recently isolated from air-raid casualties and wounded soldiers. All of these strains were tested for their capacity to produce toxins *in vitro*, and the yield varied from 5 to 80 intravenous mouse M.L.D. per cc. All but one of the strains were of a basic toxicity equal to or greater than that capable of producing gas gangrene if the wound conditions were favorable.

Bisgard and Baker (10) believe that there is ample experimental evidence that no method of treatment in use today renders a contaminated wound absolutely free of bacteria and that even surgical asepsis is never absolute. They point out that infection is dependent upon the quantity and the character of the organisms remaining in the tissues and the effectiveness of defense mechanisms.

Largely because of buried foreign bodies, such as pieces of clothing, earth, bits of stone, pebbles, straw, splinters of wood, or articles carried in pockets, war wounds produced by projectiles, pieces of shells, bombs, shrapnel, grenades, and bullets are prone to develop infection. The enhancement of infection by the presence of foreign bodies has long been recognized.

The type of wound is an important determining factor in infection. Extensive wounds containing contused and devitalized tissue furnish excellent culture material in which contaminating bacteria may get a foothold and infect the wound. Mullally (74) stresses that the larger the amount of muscle damaged, the greater the danger of gas gangrene. Lacerations of the thigh or buttocks may severely damage a pound or more of muscle, and these greatly devitalized masses may show the phenomenon of infection with gas-forming anaerobes in its most obvious form. Through-and-through bullet wounds not perforating the lumen of organs containing bacteria, such as those of the respiratory and gastrointestinal tract, rarely become infected with gas gangrene and usually heal spontaneously. The development of gas gangrene is much greater in compound fractures than in wounds of the soft parts only, in both civil and military practice (9, 70, 85).

One of the gravest features of present war wounds is their multiplicity. This is particularly evident in wounds produced by any type of bomb. They are characterized by extensive tissue disruption, severe shock, and early virulent infection.

Impairment of the local blood supply by damage or ligation of large vessels, displaced fractures, pressure of hematomas, tourniquets or ill applied and fitting casts, or increased subfascial tension due to edema or hemorrhage favors the development of wound infection. Reimers (93) gives his experiences at a base hospital in the Sino-Japanese War and states that a tourniquet is often the cause of gas gangrene. The stopping of the circulation permits any gas-forming anaerobes that are present to multiply and infect the tissues. In his experience the excision of complicated bomb wounds is impossible and no matter how carefully done, results in an infected wound.

The symbiosis of aerobes and anaerobes favors particularly the multiplication of the bacteria of gas gangrene and putrefaction (66). Whether an infection once implanted remains localized, spreads extensively, or invades the blood stream is dependent upon such factors as the nature of the wounded tissue, the virulence and dose of the contaminating bacteria, and the general resistance of the subject.

The location of the wound determines to a certain extent the development of infection. Lacerations of the neck and face are prone to heal well unless they are in communication with the mouth and pharynx. Likewise, the face, scalp, back, and thorax are affected rarely by gas gangrene (44, 66, 104), but may be by tetanus. The muscular areas of the thigh, calf, and buttock, on the other hand, are particularly prone to gas infection, while the upper extremity is less frequently involved. The retroperitoneal tissues often are the seat of a severe mixed anaerobic infection when the wound involves the colon or rectum.

"Time lag," the period between receipt of injury and surgical treatment, is usually minimal in civil practice since the majority of patients are seen in six hours or less. In military practice this "time lag" may be considerable and is said to be dependent upon many variable factors, such as (1) air equality or superiority; (2) adequate and available road space, since supplies and troops going to the front have preference over ambulances returning; (3) weather conditions; and (4) the fact that because of the intensity of the conflict, evacuation may be possible only at night. When this "time lag" exceeds the arbitrary period of twelve hours, infection succeeds contamination and thorough débridement no longer is possible.

The physical condition of the soldier when he is wounded is an important predisposing factor to infection. Although he may be in the best of health and physical condition when wounded, he may suffer great fatigue and exposure for hours or days before help comes to him. In addition, continued pain, hunger, and loss of blood may greatly reduce his power of resistance to bacterial invasion. Experience gained in the first World War (105) showed that lack of water, food, and sleep produced those physiological conditions which increased the liability to shock. This made local vascular blocking easier and predisposed to infection. In addition, severe shock may prevent adequate débridement. Brown, Dennison, Ross, and Divine (13) described their experiences at a clearing station in Britain, where in the space of twenty-four hours 500 seriously wounded men were admitted after their return from the "Hell of Flanders." Most of the wounded had survived at least one, sometimes two, three, or four days after injury with no more treatment than the first field dressing. Describing the men as coated with grime and sand, unshaven, exhausted by lack of food and sleep, shaken by continual bombardment, they marveled that the wounded survived at all. If the "time lag" has been considerable, Hook (40) points out, many wounded soldiers when seen will have suffered for hours or days from hunger, pain, and exposure. D'Abreu (20) considers exhaustion, especially when associated with severe blood loss, to be an important predisposing factor to infection. Blalock (11) states that a good state of nutrition increases a person's ability to withstand infections and injuries and

that an adequate vitamin intake, particularly of Vitamin C, is of importance in combating infections in healing wounds.

### PRINCIPLES OF TREATMENT

It has been pointed out repeatedly that although war surgery is no different than civil surgery in its principles, the execution of the principles is commonly compromised by stress, "time lag," severe shock, or lack of materials. Its primary purpose is "to save life (1) by preventing hemorrhage, (2) by allaying shock, and (3) by every possible effort to prevent infection" (72). There is often no time for plastic operations or other elaborate procedures. Hart discussed the lessons learned from the war in Spain and stated that wound excision has completely replaced attempts at local wound disinfection. Success after primary wound débridement consists in the prevention of infection or gangrene, and the chief factor in failure is the persistence of nonviable tissue or of foreign matter.

The principles of surgical treatment of fresh accidental wounds have been re-emphasized recently by Reid and Stevenson (92), Mason (61), Reid and Carter (91), Koch (50, 51), Kreuscher (52), Moorehead (73), and Strode (100). The importance of removing not only infecting organisms but any potential breeding ground is stressed. Suture of tissues within the wound under tension and buried sutures favor the development of infection. Further factors essential for successful wound healing depend upon the provision of favorable conditions for the injured tissues to undergo spontaneous repair. These include the apposition of live tissue to live tissue after thorough removal of all foreign, dead, or dying matter; and rest to promote repair and overcome infection which is almost inevitably present. The immobilization of soft parts as well as skeletal parts is important in the control of infection. Kennedy, Darrah, Wilson, and Murray (75) insist that fixation of bone fragments must be complete after débridement, or their movement will cause infection in a contaminated wound.

There is ample evidence that primary suture of a wound following adequate débridement is a safe and correct procedure in civil practice (40, 51, 61, 91). In war surgery it is probably safe only if the excision has been performed early, is complete, and is aseptic. Conditions of war and a "time lag" over twelve hours usually prevent complete débridement and favor the development of infection if primary closure is done. Mitchell (71) described his experiences with casualties from the western desert of Libya at a base hospital and found that open wounds invariably did better, while primarily sutured or tightly packed wounds rarely did well. He advocated the more frequent use of splints in soft-tissue injuries, and the removal of foreign bodies without the use of x-rays only if they were felt, were seen, or were giving severe symptoms. Moorhead's report (73) of the experience at Pearl Harbor again emphasized the inadvisability and risk of closing war wounds after débridement even when supplemented by local and general sulfonamide therapy.

The popular closed-plaster method of treating compound fractures carries out satisfactorily most of the principles of wound therapy outlined. Most reports concerning this method are favorable and encouraging. In the Spanish Civil War Trueta (102) employed the Orr-Trueta closed-plaster method in the treatment of compound fractures. After débridement, the fracture was reduced, the wound cavity was packed open with plain gauze, and a skin-tight plaster casing was applied. He reported on 1,073 patients treated in this manner. In only 8 cases did he have to remove the encasement because of infection, and in only 1 instance did gas gangrene occur. He stated that approximately 10,000 wounded received the treatment in the retreat from Calledonia. Trueta and Barnes (103) have shown experimentally that plaster casts almost completely arrest the lymph flow and prevent to a large extent the development of edema in an inflamed area. The flow of lymph from an edematous limb was very much greater than from a normal one and these authors reasoned that if bacteria and their toxins travel by the lymphatics, the arrest of the lymph flow must result in a corresponding arrest of the infection. They (103) emphasized the three scientific principles upon which the successful closed method of wound treatment is based: (1) institution of early treatment before bacteria have had time to multiply, (2) adequate excision of dead tissue before the application of a cast, and (3) complete immobilization of all muscles.

Brown, Dennison, Ross, and Divine (13) described the use of the modern closed-plaster technique for the treatment of infected war wounds in soldiers evacuated from Flanders, and found the method simple, rapid, and efficacious.

Orr-Ewing, Scott, and Gardner (80) concluded that the closed-plaster method owes its efficacy to its physical and physiological effects rather than to any specific influence on the bacterial flora. No evidence was found of any inhibitory effect on the bacillus pyocyaneus or on the growth of hemolytic streptococci or staphylococci in the wounds.

As a result of observations made on a series of compound fractures, Gardner (30) gained the impression that the bacterial flora mattered relatively little and the surgeon was paramount. If the surgical excision of the wound at the beginning had been thorough and the plaster cast satisfactorily applied, it seemed possible for even the most ghastly wounds to do well irrespective of their bacterial count.

Although most reports on the closed-plaster method are favorable, certain limitations and dangers in the treatment of compound fractures must be recognized. Gangrene may result from pressure and is the basis for the recommendation by some that unpadded plaster should not be used unless constant supervision is possible. Jolly recommends this treatment after débridement but warns that no case should be evacuated without at least twenty-four hours' observation in a forward hospital. Arnaud and his associates (4) observed 600 patients who were wounded in the Spanish Civil War and had been treated by the closed-plaster method from fifteen days to six months before. On the whole, the wounds appeared less extensive and less destructive than those observed during the first World War. Although the soft-tissue wounds had healed satisfactorily, it was found that 50 per cent of the compound fractures showed mediocre results as evidenced by malunion and nonunion, associated with overriding of the fragments, deformities, excessive callous, and multiple sequestration. All fractures of the femur showed bad results, and no wounded joint was without complicating infection. Even though many cases demonstrated no clinical signs of infection as evidenced by fever, pain, or swelling, many had infective dissection of the subcutaneous and subfascial tissues, particularly of the lower extremity. This report of Arnaud and his associates is interesting since it brings up several points for consideration. Although this method permits evacuation of the wounded soldier without great risk, it has many limitations. It is well known that many compound fractures, particularly those of the lower extremity, cannot be held in satisfactory reduction and immobilization by plaster casts. Gissane (32) used the closed method on civilian injuries and noted, on changing the plaster in those patients who had sustained gross muscular and bone injury, that it was extremely difficult to hold reduction of the fracture.

When routine primary casting is done on such fractures a large proportion of the cases inevitably will show malunion, nonunion, excessive callous formation, and infection. There is a high incidence of anaerobic bacterial contamination of war wounds, and many anaerobes are noted for their tendency to burrow and dissect through the deep tissues.

The chemotherapeutical drugs will undoubtedly play an important part in the prevention and control of wound infection. Recent evidence (12, 15, 17, 43, 45, 47, 58, 73, 82) suggests that the use of sulfonamides, either locally or generally, soon after injury may prolong the "golden period" of contamination and may therefore prove to be of great value in the treatment of war wounds in which it is impossible for any one of many reasons to administer early surgical treatment. Under such conditions delayed débridement may become possible. King (48) recorded a number of wounded cases treated by partial excision and packing with sulfanilamide powder. Good results were obtained, and the method was suggested for casualty-clearing stations to control infection until the patient arrives at a base hospital.

Key and Frankel (46) indicate that sulfanilamide, sulfapyridine, and sulfathiazole have a bacteriostatic action in wounds and are well tolerated in joints, muscle, connective tissue, the pleura, and the peritoneum. These authors recommend sulfanilamide for local use. From the reports of Moorehead (72, 73) and Strode (100) on the surgical experience at Pearl Harbor, the use of sulfonamides locally in wounds at the time of débridement was followed by excellent results and the absence of purulent exudate became a subject of universal comment. Jeffry (42) gained the impression during his treatment of war wounds in France that those treated with a sulfanilamide pack looked cleaner after an interval of five days than those that were not so treated. In 3 cases the insertion of sulfanilamide powder directly into septic knee-joint cavities, which had been exposed by shell fragments, was followed by afebrile convalescence and the absence of serious infection.

Colebrook (18) indicated that the instillation of sulfanilamide into a wound will not prevent growth of bacteria for longer than three days. For this reason he does not think it is surprising that streptococcal infection occasionally occurred two weeks after packing of the wound with sulfanilamide.

Bisgard and Baker (10) believe that sulfanilamide is very effective, but not completely so, in preventing infection in wounds grossly contaminated with specific pathogenic bacteria. Their experimental and clinical studies indicated that infection in fresh accidental wounds is most effectively prevented by copious washing with saline solution, débridement, and the implantation of

sulfanilamide. Other reports by Reed and Orr (89), Hawking (38), Selbie (64), and Armstrong and Rae (3) indicate that local chemotherapy with sulfanilamide, sulfapyridine, or sulfathiazole effectively prevents or controls experimental gas gangrene. Results of our use of sulfanilamide locally and generally in contaminated wounds after débridement at the Cincinnati General Hospital indicate that it is of some value in the prevention or control of infection. However, the sulfonamides must be considered only as adjuncts to the surgical therapy of wounds, as failure to observe the fundamental surgical principles of adequate débridement during the "golden period," of careful maintenance of an adequate blood supply, and of suture of live tissue to live tissue without tension will result in infections even though sulfanilamide is used. Zeissler (111) believes that local chemotherapy is ineffective when gas gangrene has already developed, when the wound is very severe, or when the local geographic incidence of gas edema is marked. Jensen, Johnsrud, and Nelson (43) concluded from their studies of compound fractures that sulfanilamide will not protect against gross contamination of a badly devitalized wound containing foreign infectious material. If all dirt and devitalized tissue is excised, their results indicated, a concentration of sulfanilamide following local implantation will effectively prevent infection.

The prophylactic effectiveness of tetanus antitoxin in war wounds was graphically presented in the first World War, and has since been generally accepted. More recently the use of tetanus toxoid has been adopted and promises to give excellent results, although it is too early to assess its effectiveness. At Pearl Harbor all wounded men had previously received the routine tetanus toxoid injections, and no cases of tetanus, either local or general, were seen by Moorehead (73) and Halford (33). This is remarkable in that every month, for the past seven years, 2 people in the Territory of Hawaii have developed tetanus, and 1 of them has died of it.

The effectiveness of gas-gangrene antitoxin given prophylactically in clinical cases may be seriously questioned. There are several reasons for this. Gas gangrene is a not too well defined clinical disease of multiple etiology (76, 110). A large variety of gas-forming anaerobic bacteria has been identified with this syndrome, either in pure or mixed culture. The prophylactic serum is usually composed only of the sera of the clostridium welchii, vibrion septique, and clostridium novyi. Zeissler (111) and others, however, believe that serum is a valuable adjunct to surgical treatment. He warns that small doses of serum are inadequate for prophylaxis or treatment.

The problem of infection in burns has not as yet been solved. Colebrook (18) referred to massive infection of severe third- and fourth-degree burns as one of the two outstandingly difficult problems of this war. In the first- and second-degree burns it is possible to prevent infection with many forms of treatment if the wound receives a preliminary débridement and cleansing as advocated by Davidson (21), and emphasized by McClure and Allen (63), Penberthy (81), Allen and Koch (1), Mason (62), and others. However, in extensive and severe third-degree burns, such as have been frequently seen in this war, the resultant sloughs almost inevitably become infected. The high mortality rate of burns at Pearl Harbor indicates the magnitude of the problem of burn treatment and the large amount of work that will be necessary for its solution.

It is evident that the type of treatment, the time of its administration, and the skill of its administrator determine to a great extent the effective prevention of infection of fresh accidental or war wounds. Excision of the wound is ideal but often impossible and therefore must be replaced by the excision of grossly contaminated, dead, and dying tissue as well as of all foreign bodies. Attempts at local disinfection to prevent infection in such wounds not only fail, but cause further devitalization of tissues, as repeatedly emphasized by Reid and Koch. It is important to remove any possible culture material for the contaminating bacteria. If this procedure can be done thoroughly and during the first six or eight hours, the "golden period," primary closure of the wound can be done without development of infection if it is carefully performed with adequate hemostasis, avoidance of suture of tissues under tension, and limitation of deep or buried sutures and ligatures. If, however, this "golden period" has passed before operative treatment is instituted, it is impossible to débride adequately and therefore closure of such wounds is extremely hazardous. It is certainly safer to pack all such wounds open after débridement. Moorehead (72) teaches that no war wound should be closed primarily. Although evidence of the value of local implantation of sulfonamides in the prevention and control of infection is accumulating, a review of the literature indicates that this is not sufficient in itself, and is to be used most effectively in supplement to adequate débridement.

Recently there has been interest in the methods of rapidly detecting and identifying the anaerobic bacteria of the gas-gangrene group (96) as an aid

in earlier diagnosis, and earlier and more effective treatment. Gas gangrene is feared so much as a wound complication principally because it is usually not recognized until the lesion is far advanced. The treatment of extensive wounds, in which gas gangrene is prone to develop, requires the use of large dressings, casts, or splints. Such coverings obscure the condition of the underlying wound, and gas gangrene may develop insidiously and not be recognized until forty-eight or seventy-two hours have elapsed. Such delay results in extensive incisions, unnecessary amputations, and even death. To overcome this Altemeier (2) has studied the stormy fermentation reaction and found it to be a simple means of accurately detecting the presence of the clostridium welchii in from six to twelve hours when the débrided contaminated muscle tissue was added directly to especially prepared milk media. Although gas gangrene is a clinical entity of multiple bacterial etiology, the clostridium welchii is the principal etiological agent and is present either alone or in association with other gas-producing anaerobes in from 72 to 80 per cent of the cases. Accordingly, the early and rapid detection of the clostridium welchii in tissue débrided from accidental wounds in civil life designates the group of wounds which must be watched very carefully, since from them three-fourths to four-fifths of the cases of gas gangrene may develop. The detection of the clostridium welchii is possible within twelve or fifteen hours after the accident when any gas-bacillus infection, if present, is still in the incipient stage. Close and frequent observations of such wounds, aided by x-ray examination for spreading gas shadows, permit a very early diagnosis.

Reed and Orr (88) have described a series of culture mediums which (1) support rapid growth of gas-gangrene anaerobes; (2) facilitate rapid isolation of the species, differentiation of the colony structure, and determination of the morphological character; and (3) make possible in twenty-four hours a series of biochemical reactions generally sufficient to differentiate the species.

## SUMMARY

A review of the wars of the past eighty years shows that the proportion of severe high explosive wounds is steadily and rapidly increasing, while the proportion of bullet wounds is decreasing. In the American Civil War 90 per cent of the wounds were produced by bullets and 10 per cent by shell fire, while in the first World War only 39 per cent of the wounds were caused by bullets and 60 per cent by high explosive shells or bombs. In the present war it is very probable that there will be a further large increase in the number of bomb and shell wounds. Such wounds furnish excellent opportunities for bacterial growth and infection. The bacterial flora of accidental and war wounds has been and is being studied intensely, and it is found to consist of a variety of organisms, roughly falling into two groups: (1) fecal bacteria and (2) pyogenic bacteria. The bacteria of fecal origin include aerobic forms such as enterobacilli and enterococci, as well as anaerobic forms such as the clostridia tetani, welchii, and novyi, the vibrion septique, and other spore formers associated with gas gangrene. The pyogenic group consists of staphylococci, streptococci, microaerophilic streptococci, and anaerobic streptococci.

At the time when the wound is first seen by the surgeon and throughout the first week the flora of war wounds consists principally of the bacteria of fecal origin introduced into the wound along with soil, skin, hair, clothing, or other foreign bodies. It is during this period that gas gangrene and tetanus are prone to develop. During the second week both pyogenic organisms and fecal bacteria may be found in infected war wounds, and by the third week the anaerobic fecal bacteria have been largely replaced by the staphylococcus, streptococcus and bacillus pyocyaneus. The source of these pyogenic bacteria is extremely interesting. The evidence indicates that they are principally of human origin, and that in the great majority of instances they are introduced into wounds sometime after the injury, particularly during the period of hospitalization.

To minimize this secondary infection, various methods have been devised, including early application of sterile first-aid dressing without probing of the wound, masking of both the patient and medical personnel during wound dressings, the use of oil on ward floors to eliminate dust during sweeping, and careful aseptic dressing technique designed to prevent the mechanical transfer of pyogenic infection from one wound to another, as well as dust and air droplet contamination.

The factors important in determining the development of infection include the virulent type of contaminating bacteria; the nature, duration, and location of the wound; the presence of foreign bodies; the general condition of the patient; and the type and thoroughness of treatment.

To prevent primary infection of wounds, débridement has replaced the use of wound disinfectants. The success of primary débridement is dependent upon the observance of well known principles of surgical therapy: (1) removal of all foreign bodies and devitalized tissue within the first six or eight hours; (2) suture of tissues with-

out tension and with a minimum amount of buried ligatures and sutures; (3) maintenance of an adequate blood supply; and (4) apposition of live tissue to live tissue for the promotion of healing. The local and general use of sulfonamides appears to be a therapeutical adjunct to careful débridement, but in no way does it take the place of débridement. The type of treatment, the time of its institution, and the skill of its administrator largely determine the effective prevention of wound infection.

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

**Ackland, T. H.: The Treatment of Head Wounds at a Forward Operating Center.** *Austral. N. Zealand J. Surg.*, 1942, 11: 230.

This discussion deals with compound fractures of the skull, with or without penetration of the dura, as treated at a forward operating center. The delay in removing the wounded from the line to the operating center is not more than six hours in most cases. All treatment, whether first-aid or operative, has for its main object the prevention or limitation of infection. Occasionally, control of hemorrhage, or removal of pressure from depressed bone is indicated. A small scalp wound is often associated with extensive brain or skull damage and it is, therefore, the first duty at the operating center to ascertain the degree of injury. Shock is uncommon and hemorrhage is usually slight or moderate. The most common finding is that of a patient lightly or deeply unconscious, with a strong pulse and in good general condition. The prognosis is best when the patient is conscious, and poorest when the pulse is poor and respirations are altered in the presence of deep coma. All wounds are serious, and when the dura has been penetrated a mortality of 50 per cent appears to be unavoidable.

The patient is prepared for operation with morphine (¼ gr.), and scopolamine is added if restlessness is marked. Sometimes the depth of unconsciousness eliminates the necessity of giving premedication or anesthesia. Wide and thorough shaving of the hair is of greatest importance. Operation is done under local anesthesia with 2 per cent novocain. The wound margins are narrowly excised and the wound is enlarged to permit an adequate exposure of bone. In cases of fissure fracture the skull is not opened and the wound is sutured without drainage. In cases of depressed fracture, all loose and depressed bone is removed. Only rarely is an intact dura opened, but when clinical signs of compression accompany a tense, blue, pulseless membrane, opening of the dura is indicated. When the dura has been torn, sufficient bone is removed to expose intact dura at all points and thus minimize the risk of spreading infection. The tear in the dura is never enlarged. Only readily accessible fragments are picked out of the brain, and gentle irrigation of the wound with warm, sterile saline solution, coming at low pressure from a soft rubber catheter, is used to wash out blood clot and pulped brain. A sucker is considered harmful for this purpose. No attempt is made to suture the dura. Sulfanilamide powder is applied locally, and the wound is sutured with drainage at one corner for a period of twenty-four hours. If cerebrospinal fluid accumulates under the scalp, it is either ignored and permitted to absorb, or it is removed by aspiration.

The results of treatment in cases of dural penetration showed a mortality of 50 per cent. Of 19 deaths, only 2 were due to meningitis. With increasing experience in the care of these wounds, the author's mortality rate appeared to decline.

JOHN L. LINDQUIST, M.D.

### EYE

**Schwichtenberg, A. H.: Review of Color Vision, with Some Practical Suggestions for Medical Examiners.** *Arch. Ophth.*, Chic., 1942, 27: 887.

Quite a number of men and a few women have defective color vision. The defects are hereditary, as a rule, being transmitted through the female and appearing in the male. In the military service color vision is of great importance.

Examiners must also realize that in any representative group of doctors, more than 10 per cent will be defective in color vision. These physicians should never be called upon to make decisions regarding color vision.

No test has yet proved entirely reliable or generally acceptable.

Sensation of color has three variables. Hue, saturation or purity, and luminosity.

The basis of the Young-Helmholtz theory of color vision is this:

There are 3 different kinds of cones, not histologically distinguishable, which when stimulated by a continuous spectrum give rise to the sensation of either red, green, or blue.

The classification of color vision on the basis of the Young-Helmholtz theory is shown here in outline. It refers only to the congenital type of color defect and not to the acquired type, which is nearly always found to be associated with more or less severe toxic symptoms.

*1. Trichromatic vision.* The trichromat perceives all the spectral colors which can be made up by suitable combinations of the 3 primary colors (with or without white or black added). This is normal color vision.

*2. Dichromatic vision.* The color sensations of the dichromat are based on the perception of only 2 colors. The sensation of 1 of the 3 primary colors perceived by the normal person is absent. If red is absent the condition is called protanopia; if green, it is called deuteranopia; and if blue is absent, it is called tritanopia.

*3. Monochromatic vision.* No color differentiations are made. This is extremely rare and few cases have been reported.

Perhaps the most reliable test for demonstrating the conditions just cited is that which makes use of the Ishihara book of plates.

Unfortunately, these plates are now readily available in public libraries and have even appeared together with explanatory notes in popular magazines with national circulation. Nearly all examinees know that this is a commonly used test in the military services, especially in the flying corps, and they can naturally be expected to study these plates. The diagnostic value of the plates is, therefore, much less than could be expected.

Commonly used so far as the Army is concerned, is the test based on the Edridge Green theory of color perception. Edridge Green assumed that primitive life forms had only a light sense and that color sense was a later evolutionary development. In the human range the normal individual recognizes the following 6 spectral colors: red, orange, yellow, green, blue, and violet. Persons whose color vision is defective are classified on the number of spectral colors perceived.

1. *Monochromatism.* The spectrum appears only as shades of gray.
2. *Dichromatism.* The spectrum appears as shades of gray, except that red is perceived at one end and blue-violet at the other.
3. *Trichomatism.* The 3 spectral colors seen are red, green, and violet.
4. *Tetrachromatism.* The 4 spectral colors seen are red, yellow, green, and violet.
5. *Pentachromatism.* The 5 colors seen are red, yellow, green, blue, and violet.
6. *Hexachromatism.* This is the state of the normal person, who sees the 6 spectral colors—red, orange, yellow, green, blue, and violet.
7. *Heptachromatism.* This is a rare condition. It consists of the ability to recognize, in addition to the 6 spectral colors ordinarily seen, a seventh between the blue and violet, called indigo.

An evaluation of the Holmgren yarn test, correctly performed, is given. There are a number of essentially similar techniques for the performance of the Holmgren yarn test. One of these is outlined.

If the examinee is not dangerously color blind, presumably a great injustice is done both the examinee and the government if he is disqualified. If he is qualified and is "dangerously color blind," mistaken perception of the color of flares, signal lights, colors on wires, shades of colors on maps, and so on, can easily lead to disaster involving the lives of many innocent persons as well as destruction of valuable equipment.

It is generally thought that persons who can pass the Ishihara test can be considered normal. When the Holmgren test is given properly as a "confirmatory test," only about 8 per cent will make red-green errors. Thus, roughly 92 per cent of those who show evidence of color-vision deficiency by their inability to pass the Ishihara test cannot be disqualified or qualified for appointments or commissions except on the interpretation the medical examiner wishes to place on his Holmgren findings. It is, therefore, altogether a matter of the examiner's opinion.

A brief review of the Young-Helmholtz and Edridge Green theories and classifications of color-vision defects is presented.

A correct, but not original technique for the Holmgren yarn test is also given.

A technique for the Williams lantern test is suggested; this simulates conditions of military operations more closely than other tests of color vision.

It is recommended that the Williams lantern test be used in place of the Holmgren yarn test as a confirmatory test, since it is simpler, several examinees can be tested at once, and with the technique outlined a written record is available which can be compared with the key. The examiner's color vision does not complicate the picture.

A simpler modification of the Williams lantern test has been submitted to higher authority for consideration.

LESLIE L. MCCOY, M.D.

**Graham, T. N.: Idiopathic Multiple Hemorrhagic Sarcoma (Kaposi). Report of an Unusual Case in Which the Initial Lesion Was on the Eyelid.** *Arch. Ophth.*, Chic., 1942, 27: 1188.

Idiopathic multiple hemorrhagic sarcoma was originally described by Kaposi in 1897 under the name of idiopathic multiple pigment sarcoma.

A case with the lesions limited to the right eyelids, right ear, chin, neck, and chest, with a single small lesion on the right thigh is reported. When first observed the primary lesion on the upper right eyelid had been present for eight months. Microscopic study of sections from a biopsy specimen confirmed the diagnosis. The patient was observed for three and a half years, during which time a few new lesions developed on the neck and chest but none on the extremities. He died as a result of metastases in the viscera.

A review of the literature revealed few cases in which the lesions did not appear first on the extremities. In almost all of the rare instances in which the primary lesions have appeared on the face, lesions on the hands and feet have subsequently developed.

LESLIE L. MCCOY, M.D.

**Young, J. H.: Clinical Observations and Deductions in the Therapeutic Use of Sulfonamide and Its Derivatives in Ophthalmology.** *Brit. J. Ophth.*, 1942, 26: 241.

Two of the "sulpha" drugs were chosen for study in this communication, namely sulfonamide and red "soluble" prontosil.

The prontosil was used locally in the conjunctival sac and diluted with distilled water to the strength desired from the 5 per cent solution contained in the ampoules in which it is marketed. It was found extremely useful in the diagnosis of all traumatic lesions of the cornea and conjunctiva, including all burns, chemical or otherwise. For this purpose it is used in a 2.5 per cent solution. Injured epithelial tissues take on a red raw-meat appearance so that

when prontosil is being used daily for treatment the progress of the condition can be followed without using fluorescein. Secondary infection in these cases is prevented or controlled by this local use of prontosil.

The drug has also been used preoperatively and in the treatment of blepharitis, acute conjunctivitis, chronic conjunctivitis, marginal ulcers, infected sockets, and after enucleation of the globe (the orbital wound then being filled with the drug). In acute conjunctivitis the time of healing was found to average from seven to twelve days instead of ten to seventeen days, as in the control cases treated with silver nitrate. In blepharitis the drug also aided in localizing the more affected areas, although complete cure was not effected without attention to other factors.

There seem to be no incompatabilities for prontosil, and other drugs may be used simultaneously without disadvantage. No cases of allergy to the drug were encountered and the staining of the tissues is never permanent. The 2.5 per cent solution seems to be the most satisfactory for general use. The author found the therapy of so many ocular conditions satisfactory with prontosil that he warns against a feeling of false confidence in order that the primary cause of the condition will not be overlooked.

Sulfonamide has been found extremely valuable prophylactically as preoperative medication in any intraocular surgery. In many of the cases the red "soluble" prontosil is used as an additional safeguard. Sulfonamide is also of value in the treatment of uveitis, prehypopyon ulcers, nonspecific episcleritis, cellulitis of the orbit, stitch (abscess) cellulitis, intraocular infections, and trachoma. It has been found helpful to employ the drug in iritis before the specific etiology has been determined. It is also of great value in combating the reactions which result from the removal of septic foci.

Sulfonamide has been employed in doses of 15 gr. every four hours. The only complications so far noted were: cyanosis, drug fever, acidosis, dizziness, and headache. No special point is made by the author of any study of the blood levels of the drug.

A number of cases are reported in which either prontosil or sulfonamide has been used for treatment with good results. WILLIAM A. MANN, M.D.

**Buley, H. M., and Albers, E. S.: Tryparsamide Therapy and Impairment of the Optic Nerve.** *Illinois M. J.*, 1942, 81: 477.

The authors discuss the effectiveness of tryparsamide in the treatment of neurosyphilis and the effect of the drug on the optic nerve.

Tryparsamide is a pentavalent arsenical, readily soluble in distilled water. Its arsenic content is about 25 per cent. Its toxicity is low and its rate of penetration into the central nervous system is high. Tryparsamide is eliminated rapidly—about 90 per cent leaves the body during the first twenty-four hours following administration. Its spirocheticidal action is lower than that of other antisyphilitic drugs. It is usually administered intravenously once a week in doses of from 1 to 3 gm. dissolved in from 5 to 10 cc. of distilled water. These injections may be given in association with heavy metals or iodides.

Tryparsamide is considered an important drug for the treatment of neurosyphilis not only because it passes with ease between the blood and the spinal fluid but also because its toxicity is lower than that of other arsenicals. Moreover, the results obtained from tryparsamide are often as good as those obtained from malaria therapy, and if tryparsamide fails malaria therapy may still be used later.

Tryparsamide therapy is indicated in all forms of neurosyphilis in which the usual methods of antisyphilitic treatment have proved ineffective and it is especially useful in cardiovascular syphilis. Tryparsamide is contraindicated in cases in which there is no response to it clinically or serologically after a period of one year; in cases of intolerance to the drug; in the early infectious period of syphilis and in all forms of late syphilis in which there is no involvement of the nervous system; in paresis if there are no contraindications to fever therapy; in hepatic insufficiency; in pregnancy; in cases in which the optic nerve is affected by the disease or if eye symptoms develop after the drug is injected; and in tabes dorsalis even if the optic nerves are normal.

Some of the complications of tryparsamide therapy are dermatitis, jaundice, nitroid crisis, hallucinations, delusions of persecution, acute insanity, and sudden impairment of vision. In 3 or 4 per cent of the patients whose eyes were previously normal loss of vision occurred in from twenty-four to forty-eight hours after one of the first 10 injections. If the eyes are affected the patient usually complains of dazzling, heat waves, light flashes, or spots. Ophthalmoscopic examination may be negative but perimetric examination usually reveals generalized contraction of all parts of the peripheral visual fields except the temporal part. In some cases the patient may become totally blind after one intravenous injection of tryparsamide. It is important to differentiate between optic atrophy resulting from syphilis and optic atrophy which is secondary to tryparsamide therapy. Syphilitic optic atrophy is characterized by concentric contraction without sparing of the temporal field and by central or cecocentral scotoma with or without contraction of the peripheral fields; secondary atrophy of the optic nerve is usually characterized by peripheral contraction with sparing of the temporal field.

Buley and Albers report 1 case in which rapid loss of vision followed the injection of tryparsamide. Subjective symptoms preceded objective findings of atrophy of the optic nerve. They report another case in which imminent atrophy of the optic nerve was prevented by the administration of Vitamins $B_1$ and B complex and of 1 gm. of sodium thiosulfate intravenously. They conclude that tryparsamide is a useful drug for late neurosyphilis and that damage to the optic nerve may be avoided by thorough and

regular checking of the visual fields and the administration of adequate amounts of Vitamins $B_1$ and B complex simultaneously with the administration of tryparsamide. JOSHUA ZUCKERMAN, M.D.

## EAR

**Campbell, P. A.: Otolaryngological Problems of Aviation in World War II.** *Ann. Otol. Rhinol.*, 1942, 51: 293.

Aviation of World War II has been characterized by widespread increase in speed, altitude of operation, motor power, and number of men involved. These changes have influenced the development of otolaryngological phases of aviation.

Campbell lists the otolaryngological problems in the order of their importance: (1) selection; (2) the effect of flight upon hearing; (3) aero-otitis media; (4) airsickness; (5) aerosinusitis; (6) the effect of altitude on the voice; and (7) the effect of anoxia upon the hearing mechanism. The interested reader should refer to the original article for further details.

NOAH D. FABRICANT, M.D.

## MOUTH

**Fastlicht, S.: Orthodontics and Dentistry in Latin America.** *J. Am. Dent. Ass.*, 1942, 29: 945.

The author presents an interesting and much needed tabulation of the dental schools of the Latin-American countries, and some information regarding the program of instruction and the facilities. Included are remarks on the dental periodicals, the dental societies, and the teaching and practice of orthodontics. The author lists the countries and the number of dental schools as follows:

Mexico, 5; Guatemala, 1; Salvador, 1; Nicaragua, 1; Venezuela, 2; Colombia, 2; Ecuador, 2; Brazil, 5; Peru, 1; Bolivia, 3; Chile, 2; Paraguay, 2; Uruguay, 1; Argentina, 3; Cuba, 1; Haiti, 1; and the Dominican Republic, 1.

It is especially interesting to compare the number of practicing dentists with the number of dental students. The author reports approximately 1,600 dentists in Mexico, and 400 students in one of the 5 dental schools. Argentina has an estimated 1,800 students in 3 schools, but only 4,464 practicing dentists.

The author expresses the belief that great benefits will result from closer acquaintance between the dentists of the various countries of the Americas, but emphasizes the fact that all countries will expect to have professional relations established on the basis of equality. CHARLES W. FREEMAN, D.D.S.

**Collins, R. O., Jensen, A. L., and Becks, H.: Study of Caries-Free Individuals. Is an Optimum Diet or a Reduced Carbohydrate Intake Required to Arrest Dental Caries?** *J. Am. Dent. Ass.*, 1942, 29: 1169.

This study concerns two beliefs—one that an "optimum diet" and the other that a "low carbohydrate diet" is the deciding factor in the control of dental caries.

This investigation was based upon a study of a highly selected group of American college youths which the author states constituted approximately 1 per cent of all the students examined.

There is given a rather complete plan with an analysis sufficient for the study of average diets. Such possible influential factors, such as heredity, familial tendencies, environment, geographic location, and some dietary essentials, omitted in the study, were not considered.

The importance of clinical examination to determine the presence of caries, supported by bacteriological tests for lactobacillus acidophilus and careful x-ray examinations, was indicated.

The results of this study seem to indicate that there is a direct relationship between active caries, a high lactobacillus acidophilus count, and concentrated sweets, and that, therefore, a reduced carbohydrate intake seems to be closer to the solution of the problem of the prevention of dental caries than other nutritional factors.

WILLIAM J. SKILLEN, M.D.

**Berry, H. C.: The Implantation Method for Setting Fractured Mandibles.** *Am. J. Orthodont.*, 1942, 28: 292.

In fractures of the mandible, the method of fixation which will obtain the best result with the least amount of pain and disfigurement should be used.

The author describes a technique which aids in the reduction of malposed fragments and serves as an efficient means of fixation in the partially or totally edentulous mandible when interdental wiring cannot be carried out. It can be used orally as well as on the outside of the face.

The appliance consists of special vitallium screws placed upright in the mandible on both sides of the fractures in the same position as the teeth. These screws are connected with an alignment rod which may be bent and adapted to hold the fragments in the desired positions.

Four cases are described in which the screws were used in the mouth with good results and without infection.

One case with multiple fractures of the mandible and infection of the bone already present is reported. The screws in this case were used extraorally with excellent results in view of the amount of trauma and infection present. LOUIS T. BYARS, M.D.

**Rushton, M. A., and Walker, F. A.: Mandibular Fractures Treated by Pin Fixation.** *Am. J. Orthodont.*, 1942, 28: 307.

Encouraging results are reported after a year's trial of pin fixation of edentulous fragments of the mandible in the more difficult cases. These are based on an analysis of 21 cases.

The apparatus and technique are described. Pins are drilled into the fragments through the skin in convergent pairs, and these are joined by bars and

universal movement clamps which permit rigid control of the fragments in every plane, so that any tilting or deviation can be corrected. The final position should be verified with x-rays.

The authors find that patients are remarkably comfortable the day following the operation, and since the jaws are not fixed together, mouth hygiene and feeding are facilitated.

The apparatus is worn from four to seven weeks, the length of time depending on the rate of union, and then is removed, usually without anesthesia.

Complications of local sequestration, alveolar abscess, and local cellulitis are mentioned, none of which seemed to delay union of the fractures.

The authors conclude that the method described has given better results in certain difficult cases than they could have obtained by other methods.

LOUIS T. BYARS, M.D.

## NECK

**Pennington, W. H.: Goiter in Central Kentucky.** *South. Surgeon*, 1942, 11: 490.

Central Kentucky water has 4.69 parts of iodine per 1,000,000. However, the eastern mountainous part, from which most goiter comes, has 2.05 parts of iodine per 1,000,000. This proportion is higher than the less than 1 part per 1,000,000 around Lake Erie and Lake Michigan, and therefore the author believes that the Kentucky section has an abnormally high incidence of goiter. The study comprises a ten-year period. The goiter admissions represented 4 per cent of the general surgical group, a total of 1,155 thyroid cases, of which 55 were not treated surgically.

The classification made was that of the American Association for the study of goiter. Four hundred and sixty-one of the 1,098 patients who underwent operation had toxic diffuse goiters; 5 of them died, 2 from thyrotoxic crisis, 1 from miliary tuberculosis, 1 from tracheal collapse, and 1 from cardiac failure. The preoperative preparation was the usual one; the anesthetics were mostly cyclopropane, although 60 per cent of the earlier patients were operated upon under local anesthesia.

The nontoxic diffuse goiters numbered 126, with 1 death due to cancer of the lung. Toxic nodular goiters occurred in 277 patients with 5 deaths, all in people of sixty years or older. This was the highest mortality in any of the groups. Two hundred and seventy-three patients had nontoxic nodular goiter, with 1 death due to tracheal collapse. Nine patients had malignant tumors, an unusually low incidence; 4 had tuberculosis, and 3 had Hashimoto goiter. No Riedel's struma was observed. The all-over mortality was 1.27 per cent; the toxic group had a mortality of 3 per cent, and the nontoxic group one of 0.5 per cent.

The stage operations are definitely indicated in the massive nodular types of goiter and for the severely toxic patients.

The mortality rate did not always drop with increasing experience in years, but it could be definitely reduced with improved nursing care.

FRED S. MODERN, M.D.

**Robertson, J. D.: Calcium and Phosphorus Excretion in Thyrotoxicosis and Myxedema. Untreated Thyrotoxicosis; Effect of Iodine; Results of Subtotal Thyroidectomy.** *Lancet*, Lond., 1942, 242: 672.

In untreated thyrotoxicosis the serum calcium and inorganic phosphorus are diminished; subtotal thyroidectomy, in the absence of any impairment of the parathyroids, results in a return of the serum calcium and inorganic phosphorus to normal.

In untreated thyrotoxicosis the calcium output is above normal. The increased loss of calcium is in the urinary output only, the fecal loss being essentially normal. Iodine causes a significant diminution in the mean calcium output, but the output still remains above normal. Subtotal thyroidectomy results in a return of the mean calcium output to normal.

In untreated thyrotoxicosis the phosphorus balance is more negative than normal and the loss is predominantly in the urine. Iodine therapy results in a return of the mean phosphorus balance to normal. Subtotal thyroidectomy lowers the phosphorus balance to below normal.

In untreated myxedema the serum calcium and inorganic phosphorus are normal while the serum phosphatase is diminished. With thyroid feeding, the serum calcium falls and the inorganic phosphorus rises. The serum phosphatase rises to normal. In untreated myxedema the calcium is diminished. Thyroid feeding increases the calcium output to normal. The fall in the calcium output affects only the urine. The fecal output of calcium is normal in myxedema, and is not affected by the thyroid feeding.

In untreated myxedema the phosphorus balance is positive, compared with a negative balance in normal people. Thyroid feeding converts the positive balance into a negative balance. The diminution in phosphorus output is in the urine. There is a normal fecal output of phosphorus. Thyroid feeding produces a great increase in the phosphaturia and a fall in the output of phosphorus in the feces to below normal.

It is suggested that thyroxin directly affects the renal threshold for calcium. Excessive secretion of thyroxin in thyrotoxicosis lowers the threshold, whereas deficient secretion in myxedema raises it.

The raised excretion of phosphorus in thyrotoxicosis and the lowered excretion in myxedema are probably secondary to the changes in calcium excretion.

FRED S. MODERN, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS; CRANIAL NERVES

**Anderson, F. M. and Adelstein, L. J.: Ganglion-Cell Tumor (Ganglioglioma) in the Third Ventricle. Operative Removal with Clinical Recovery.** *Arch. Surg.*, 1942, 45: 129.

A case of tumor of the third ventricle (ganglioglioma) with operative removal and clinical recovery is reported. The most common site of origin of these ganglion-cell tumors appears to be the floor of the third ventricle. The most prominent clinical manifestations include hypersomnia, psychic disturbances, sympathetic symptoms (disturbances in temperature regulation, genital dystrophy, adiposity, "diencephalic epilepsy"), thalomic symptoms (painful hypesthesia and central pain), and various cerebellar phenomena.

Ventriculography is indicated whenever the condition is suspected. In the opinion of most authors, a frontal approach through the dilated lateral ventricle is the technique of choice.

J. M. MORA, M.D.

**Walker, A. E.: Mesencephalic Tractotomy—A Method for the Relief of Unilateral Intractable Pain.** *Arch. Surg.*, 1942, 44: 953.

Chordotomy relieves intractable pain in the lower limbs, abdomen, and thorax. Due to the danger of respiratory failure from high cervical incisions, it is not used for the relief of pain in the upper limbs. In such cases posterior rhizotomy has been suggested, but this is not satisfactory since the upper extremity becomes anesthetic and useless. This procedure is of more value for the relief of pain in the neck. For pain in the arm, neck, and face Dogliotti suggested section of the lemniscus lateralis in the rostral part of the pons.

Equally effective and simpler section of the pain fibers from one-half of the body including the face may be carried out in the mesencephalon. This has the following advantages over Dogliotti's procedure:

1. The site of the operation can be reached without retraction of the cerebellum.
2. The incision is made a considerable distance from the superior cerebellar artery and the fourth cranial nerve.
3. It may be carried out deeply into the brain stem without damaging of the brachium conjunctivum which lies immediately below the pain fibers in the upper part of the pons.
4. The landmarks are clearer.

The operation has been performed on 2 patients. A posterior temporal osteoplastic craniotomy is made. The dura is opened with a horseshoe incision, the toe being cut along the lateral sinus and reflected upward. The lateral surface of the temporal lobe is elevated and the tentorium incised at the incisura.

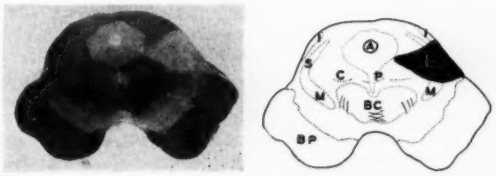



Fig. 1. An untouched photomicrograph of a section at the point of maximum damage to the mesencephalon (immediately caudal to the superior colliculus) and a sketch of the section with the tracts labeled: *A*, aqueductus sylvii; *BC*, brachium conjunctivum; *BP*, basis pedunculi; *C*, tractus centralis tegmenti; *I*, brachium colliculi inferioris; *L*, lesion; *M*, lemniscus medialis; *P*, fasciculus longitudinalis medialis; *S*, tractus spinothalamicus. The section was stained by Smith-Quigley technique for myelin. ×3.

This exposes the mesencephalon covered by arachnoid, and the superior cerebellar artery is seen in the angle between the cerebellum and tectum mesencephali. The arachnoid is retracted from the lateral surface of the midbrain. A special Bovie point having a lead marker 3 mm. from the end is plunged into the mesencephalon near the rostral margin of the inferior colliculus at the lateral sulcus (Fig. 1).

In man, the pain pathways from the lower limbs, abdomen, thorax, and upper limbs lie on the surface of the mesencephalon just above the lateral sulcus and scattered throughout the extent of the lateral lemniscus. In the monkey, the secondary pain fibers from the trigeminal nucleus lie at the level of the lateral sulcus along the lateral margin of the medial lemniscus, and it seems likely that their localization is somewhat similar in man. Mesencephalic tractotomy will abolish pain and temperature sensations on the opposite side of the body, including the face, while leaving intact touch, deep sensation, and motor power.

DAVID J. IMPASTATO, M.D.

**Watts, J. W., and Freeman, W.: The Surgical Aspects of Prefrontal Lobotomy.** *J. Internat. Coll. Surgeons*, 1942, 5: 233.

Prefrontal lobotomy was performed in 131 patients with mental disorders. Contrast media were injected at operation, and the depth and extent of the incisions in the frontal lobe were verified by roentgenograms in nearly all of the cases. Best results were obtained when the lobotomy was made in the plane of the coronal suture. When the incision was made too far anteriorly, there was temporary or no relief from the mental symptoms, while if it was made too far posteriorly, there was profound inertia, dullness, and disorientation, which later went over into a state of bland and euphoric indifference. If insufficient white matter was cut, the mental symptoms were not permanently relieved. The oper-

ation must be done symmetrically on both sides. It is the opinion of the authors that the profound emotional alterations, in the absence of any serious intellectual deficit, are the result of section of the thalamofrontal pathway.

It is important to tell the patient's relatives what they may expect following the operation and inform them of the risks involved. Local anesthesia is used in about half of the cases, while avertin is used in the cases of those who are agitated or unco-operative.

In the first 20 cases, the Moniz technique was used, but within a few months many relapses had occurred, and the technique was altered. The present technique consists in cutting the white matter of each frontal lobe in the plane of the coronal suture, which passes just anterior to the tip of the frontal horn of the ventricle. The operation is carried out through a burr hole 1.5 cm. in diameter over the lateral aspect of the frontal lobe, about 2.5 cm. above the floor of the frontal fossa. The technique is described and illustrated in detail.

The information necessary to incise the frontal lobe in the plane of the coronal suture anterior to the tip of the ventricle involves locating the tip of the lateral ventricle, the sphenoidal ridge, the median longitudinal fissure, and three points on the coronal suture. A blunt dissector is inserted along the track made by a cannula; thus the gray matter on the medial surface of the frontal lobe is avoided. The danger of lacerating blood vessels is reduced by not approaching too closely to the midline. The section is made from the center toward the periphery. The white matter is cut in the upper and lower parts of both frontal lobes. After the incisions have been made, a few drops of lipiodol are injected so that the exact location of the lobotomy can be determined. A second and sometimes a third operation are necessary in patients who fail to obtain relief from mental symptoms.

It has been repeatedly observed that a satisfactory result occurs only when lobotomy produces drowsiness and disorientation, and therefore these symptoms are used as a yardstick to determine the depth and extent of incision when the patient is being operated upon under local anesthesia. Drowsiness and confusion are more prominent on the three days following operation than on the day of operation. These symptoms begin to clear up between the fifth and tenth days. Postoperative care is outlined.

There have been 3 operative deaths among the 131 patients, and all occurred in the first half of the series. In 51 patients operation has been too recent to evaluate the results. Of the first 80 patients, 50 have obtained a good result. The best outcome has occurred in involutional depressions and obsessive tension states. JOHN L. LINDQUIST, M.D.

**Hyndman, O. R.: Tic Douloureux. Partial Sections of the Sensory Root of Varying Extent.** *J. Internat. Coll. Surgeons*, 1942, 5: 192.

Since partial section of the sensory root of the fifth cranial nerve was suggested, many studies have been made to determine the distribution of the components of that root in the face. The author has attempted in 6 cases to perform gradually less extensive sections of the sensory root and to correlate these with careful postoperative sensory tests of the face. The cases are clearly and diagrammatically presented in the article with figures showing the extent of the particular root section and the resulting sensory loss.

All of the patients suffered with trigeminal neuralgia and all were completely relieved of their symptoms following operation. The examinations recorded were made at different intervals after operation and in each case the result of a single examination is shown; the time intervals were: Case 1—ten months; Case 2—eight and one-half months; Case 3—six and one-half months, Case 4—twelve days, Case 5—eight days, and Case 6—eight days. One extra case of post-herpetic neuralgia in the left ophthalmic distribution (previously reported) is mentioned, for in this case the upper part of the sensory root was cut and the lower part spared. In this case there was considerable sparing of sensation over the forehead and cheek.

The principal object of the article is to show the importance of oral and perioral trigger zones which, if rendered anesthetic, relieve the condition of trigeminal neuralgia. Intraoral sensation of fifth-nerve distribution is supplied by the lower fibers of the sensory root just posterior to the ganglia; hence, if the author's idea is correct, only the lower part of the sensory root need be sectioned to relieve the patient's pain. This minimal section, that is, section of the lower part of the root, has distinct physiological advantages especially with regard to corneal sensation.

It is only fair to state that many neurosurgeons have noted a recurrence of the typical pain in the ophthalmic division when the upper part of the sensory root had been spared. This frequently occurred several years after the original operation, during which interval the patient had been regarded as cured. Furthermore, trigger zones in the ophthalmic distribution of the ophthalmic division are frequently noted. ADRIEN VERBRUGGHEN, M.D

## SPINAL CORD AND ITS COVERINGS

**Busch, E.: Air Myelography in the Diagnosis of Protrusion of Lumbar Intervertebral Discs and of Ligamentary Compression of the Nerve Roots** (Luftmyelographie zur Diagnose des lumbalen Discusprolapsus und der ligamentaeren Wurzelkompression). *Acta radiol.*, Stockh., 1941, 22: 556.

Busch has treated 38 cases of verified protrusion of the intervertebral disc and 8 cases of definite ligamentary root compression (which is called "hypertrophy of the ligamentum flavum" in the American literature, but for which he believes his designation is preferable) after examination with iodized oil myelography, and 59 "disc" cases and 5 cases of hypertrophy of the ligamentum flavum, after study by air myelography, in the Department of Neurosurgery

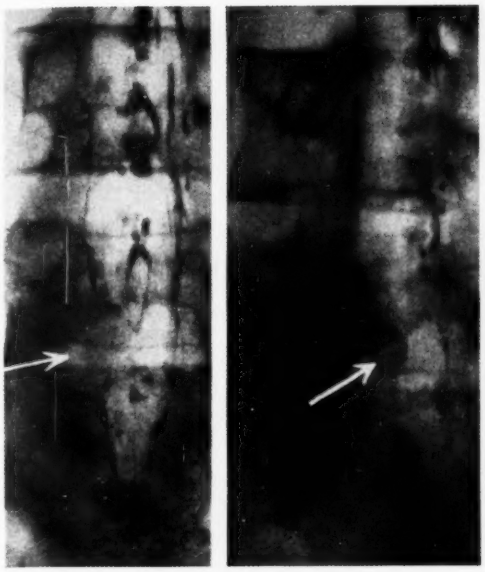


Fig. 1. Lateral intervertebral-disc protrusion. Six months before this study was done, an iodized-oil injection had been given in another hospital; the oil veiled the protrusion, and as no fluoroscopy had been done, the protrusion was overlooked by the otherwise experienced roentgenologist. It was clearly demonstrated by air myelography.
Fig. 2. Same patient as in Fig. 1. Oblique exposure.

of the Rigshospitalet in Copenhagen. He definitely prefers air or oxygen as a contrast medium, as it is resorbed more rapidly.

The moistened and warmed oxygen is introduced fractionally by lumbar puncture, in slight elevation of the pelvis, after the withdrawal of from 40 to 50 cc. of spinal fluid. Then additional oxygen is injected, until there is a positive pressure between 250 and 300 mm. of water. There may be slight paresthesias in the legs, but no pain. After removal of the spinal puncture needle (closed system!) the following exposures are made: transverse; anteroposterior; right and left oblique (rotation of 20°); transverse from the other side; and special exposures of the fifth lumbar intervertebral space in both lateral decubitus positions with a small diaphragm opening. The exposures may be done stereoscopically. After the roentgen studies are finished the excess gas is removed from the spinal canal by another lumbar puncture. It is possible to finish this examination with encephalography.

This technique (excluding encephalography) should be within the reach of every general hospital. While a tilting examining table is advantageous, it is not indispensable, as elevation of the foot end of an ordinary table will serve almost as well. The examination is brief and gives more information than iodized-oil studies. The patient will not carry deposits of thickened oil subarachnoidally which, incidentally, could interfere with subsequent examinations.

The method must not be used in patients in whom there may be an intracranial tumor of the posterior fossa. Otherwise, the method is free of dangers, and the only disagreeable after-effect is headache, but even this occurs rarely.

The ability to read the pictures increases with experience. There is but little difficulty to diagnose median-disc protrusion and compression of the ligamentary root, but small lateral disc protrusions may be difficult to discover, and on rare occasions may require additional oil myelography.

According to Busch, air myelography is indicated (a) in the typical case of intervertebral disc damage, i.e., in a patient with a history of an adequate trauma to the back, radicular pain increasing with the increase of intra-abdominal pressure, hypesthesia of the lateral aspect of the lower leg on the involved side, and in the absence of the Achilles reflex; (b) in the nontypical case with similar but less distinct symptoms; and (c) in patients with chronically recurring sciatica attacks—the largest and most difficult group. Myelography should not be done for patients with first attacks of lumbago or sciatica.

HEINRICH LAMM, M.D.

**Munro, D., and Harding, W. G., II: Lumbar Puncture; Its Potential Role in the Production of Injuries to the Intervertebral Disc.** *J. Am. M. Ass.*, 1942, 119: 482.

Low back pain, as a result of injury to the intervertebral disc from lumbar puncture, may be a common clinical syndrome. Spinal puncture in an immobile patient held in acute flexion may supply the penetrating force from which herniation of the

Fig. 1. Position of needles.

nucleus pulposus can occur through the annulus fibrosus damaged either by excessive stretching or by needle puncture. Herniation of the nucleus pulposus through the posterior section of the annulus fibrosus results in pressure symptoms on the spinal nerve roots in the region of the intervertebral foramina and is especially prone to develop in the region of the fourth and fifth lumbar vertebrae. A plea for the abandonment of flexion of the spine as an unnecessary maneuver for lumbar puncture was made previously by the senior author.

A series of lateral x-ray spine plates with spinal needles placed in the subarachnoid space at various levels yielded data for special observations on the relation of the course of the spinal needle to the intervertebral space. Of 12 lumbar punctures between the third and fourth lumbar vertebrae, 75 per cent were directed toward the intervertebral space, and in 42 per cent of spinal punctures between the fourth and fifth lumbar vertebra, the needle was within 4 or 5 mm. of the annulus fibrosus.

It is suggested, therefore, that spinal puncture be done without forced flexion of the spine and that the site of puncture be made between the 5th lumbar vertebra and the 1st sacral vertebra.

BENJAMIN G. P. SHAFIROFF, M.D.

## SYMPATHETIC NERVES

**Shumacker, H. B.: The Value of Skin-Resistance Studies in Determining the Accuracy of Procaine Injections to the Sympathetic Nerves.** *Surgery*, 1942, 11: 949.

The injection of sympathetic nerves and ganglia with a local anesthetic agent is a definite and essential step in determining the role played by that system in a given syndrome. The same procedure is of value in evaluating pain that may be conducted over sympathetic nerves. Certain peripheral vascular diseases have a large sympathetic component while others are mainly due to obliteration of the blood vessels.

In obliterative vascular disease it is often difficult to estimate the amount of concomitant vasospasm. Plethysmographs, oscillometers, and blood-flow studies have been employed, but up to the present, skin temperature studies have been of most value. It has recently been pointed out that skin which has been deprived of its sympathetic enervation is very resistant to the passage of a small electric current. When this fact is applied to the study of peripheral vascular disorders, it provides valuable additional information. This is true especially in cases of obliterative vascular disease in which a procaine sympathetic block is being used. It is important to be sure that a satisfactory sympathetic block has been obtained. The skin temperature control may show little rise in temperature, which could be due either to the obliterative completeness of the condition or to an unsatisfactory block. The increase of skin resistance in such a case would indicate a satisfactory block and thus show the true nature of the condition.

The author has studied this particular phase of peripheral vascular disease in 21 cases. His results are tabulated and appropriate illustrative figures are provided. The instrument employed is described and is similar to that used by Levine. The readings were made with kaolin paste on the electrode. In 1 case the skin resistance increased immediately following a lumbar sympathetic block, but the expected skin temperature rise lagged behind by one hour. Operative sympathectomy was followed by a great increase in warmth. Certain cases in which preoperative tests showed little rise in skin temperature have had surprisingly good results from sympathectomy. In these the suspicion of a poor diagnostic sympathetic block would have been removed by skin-resistance tests. ADRIEN VERBRUGGHEN, M.D.

**Hyndman, O. R., and Wolkin, J.: Sympathectomy of the Upper Extremity. Evidence That Only the Second Dorsal Ganglion Need Be Removed for Complete Sympathectomy.** *Arch. Surg.*, 1942, 45: 145.

The authors outline the protocols of 5 cases as evidence to show that removal of only the second dorsal sympathetic ganglion results in as complete a sympathectomy insofar as central connections of the arm are concerned, as does removal of the inferior cervical and upper two dorsal ganglions (the standard cervocodorsal ganglionectomy). They conclude that no sympathetic fibers which supply the skin structures of the face and upper extremity reside in the first thoracic root in man. Operative removal of only the second dorsal ganglion is a simple procedure which insures a complete sympathectomy to the upper extremity and optimal physiological results that can be attributed to efferent sympathectomy.

DAVID J. IMPASTATO, M.D.

# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

**Cohn, L. C.: Carcinoma of the Female Breast. An Analysis of the End-Results after Five Years in 192 Cases, with Special Consideration of Preoperative Irradiation.** *Arch. Surg.*, 1942, 44: 715.

Ninety-four patients with carcinoma of the breast were subjected to a complete operation. Forty-five per cent of this group had five-year cures. In 51 of these cases the treatment was entirely surgical, and of this group 35 per cent had five-year cures. In 43 cases preoperative irradiation was carried out in addition to surgery and of this group 57 per cent had five-year cures. However, the end-results have been largely determined by the grade of the tumor and the condition of the axillary lymph nodes at the time of operation.

Twenty patients with operable lesions did not have a complete operation and of these 42 per cent had five-year cures. This group includes patients treated by simple excision of the tumor and post-operative irradiation, or by simple amputation of the breast. The majority of the latter received pre-operative irradiation. Two factors are believed to have influenced these relatively good results—the fact that many of these patients had low-grade tumors and the fact that they had irradiation therapy.

In 68 cases of inoperable and recurrent carcinoma of the breast there were less than 1 per cent five-year cures. Irradiation in 67 of these cases did not seem to affect the results materially.

EDWARD W. GIBBS, M.D.

**Williams, I. G.: Carcinoma of the Male Breast.** *Lancet*, Lond., 1942, 242: 701.

The basis of this report is 20 cases of carcinoma of the male breast seen during the decade from 1931 to 1940 at the Middlesex Hospital. This number represented a ratio of 1 to 88, as compared to the incidence of 1,573 cases of carcinoma of the breast in women.

The average age of the patients was 55, slightly higher than the average age in women. Many of the patients gave a history of a lump in the breast of years' duration. A history of trauma was obtained in 4 cases, the significance of the history being problematical.

Clinically, skin attachment was present in all cases. Six cases were classified as operable; 6 cases were classified as being of borderline operability; and 8 cases were inoperable clinically.

Pathologically, carcinoma of the male breast is identical with carcinoma of the female breast, the various types being recognized. Adenocarcinoma is the most common type.

The following plan of treatment is suggested:

1. All cases should receive radiotherapy, preferably preoperatively.
2. Simple mastectomy, together with radiotherapy, is sufficient when the tumor is confined to the breast (Stage 1).
3. Radical mastectomy with preoperative roentgen irradiation is advised in cases in which axillary metastases are present (Stage 2).
4. Stage 3 cases, with metastases beyond the axilla, are treated with radiotherapy alone.

The degree of malignancy and the extent of anatomical spread, both, have an important bearing on survival.

LUTHER H. WOLFF, M.D.

**Hill, R. P., and Stout, A. P.: Sarcoma of the Breast.** *Arch. Surg.*, 1942, 44: 723.

The authors reviewed the literature on sarcoma of the breast and separated the diverse forms into the following groups in accordance with the histogenesis:

1. Adenofibrosarcoma
2. Fibrosarcoma
3. Lymphoblastoma
4. Malignant hemangioendothelioma
5. Liposarcoma and myosarcoma
6. Mixed tumor

This classification is particularly advantageous with regard to the prognosis of this condition.

Adenofibrosarcoma is a rather specific type of breast tumor and represents a sarcomatous transformation of fibroadenoma. It may arise in a pericanalicular fibroadenoma or in an intracanalicular fibroadenoma. The latter is commonly called cystosarcoma phyllodes or cystosarcoma and often reaches an enormous size. Adenofibrosarcoma is the most common type of breast sarcoma and is relatively benign.

Fibrosarcoma arises from the ordinary connective tissue of the breast and is as malignant as fibrosarcoma arising elsewhere. The symptoms are about the same as those of adenosarcoma but the tendency for recurrence and metastasis is much greater, although it is less than that of carcinoma. The presence of bone or cartilage is thought to represent metaplasia in fibrosarcoma or adenofibrosarcoma rather than the result of a teratoma.

Lymphoblastoma includes lymphosarcoma, leucemic tumors, chloroma, and Hodgkin's disease. All are rare in the breast and all are prone to pursue a rapid and fatal course.

Malignant hemangioendothelioma is of variable malignancy. The better differentiated tumors tend to grow slowly and metastasize late, while the more embryonic forms pursue a more rapid course.

Liposarcoma and myosarcoma are very rare but seem to possess a high degree of malignancy. Clinically they resemble fibrosarcoma and are differentiated only by histological study.

The mixed tumor group includes mammary neoplasms which contain two or more different tissues.

The authors discuss the clinical picture, the gross and microscopic pathology, the course, and the treatment of these groups of breast tumors, and include a very adequate survey of the literature on this subject. EDWARD W. GIBBS, M.D.

## TRACHEA, LUNGS, AND PLEURA

**Potter, B. P.: A Study Concerning Clinical and Anatomical Features of Re-Expanded Lungs Which Had Been Collapsed by Pneumothorax for Variable Periods of Time.** *J. Thorac. Surg.*, 1942, 11: 554.

A study of the results following re-expansion of collapsed lungs in 162 cases of pneumothorax performed on 118 patients forms the basis for this report. The main interest was the type of healing that takes place and the respiratory capacity following re-expansion of collapsed lungs. The lesions present in these cases consisted of multiple cavities in 40, one cavity of 2 cm. or less in 44, from 2½ to 3½ cm. in 57, from 3½ to 5 cm. in 8, and 5 cm. or more in 8, and progressive infiltration in 5.

The complications of pneumothorax observed in these cases consisted of tuberculous empyema in 5, spontaneous pneumothorax in 4, mediastinal deviation or herniation in 5, and atelectasis of an entire lobe or of an entire lung in 14. Extensive effusions were observed in 70 per cent of the cases. Of the 118 cases 12 presented large cavities in both lungs and were thus bilateral pneumothorax-collapse cases.

Collapse therapy should be continued for a minimum period of eighteen months. In patients with larger cavities this should be increased to four or five years, or even longer. Although in this group of cases the minimum of eighteen months was planned, it was not obtained in 26 instances, in which either adhesions or effusions brought about re-expansion of the lung from five to sixteen months after an effectual collapse had been established.

The results of the collapse therapy in this group of cases show that more recurrences of active disease were found when it was impossible to maintain treatment for the minimum period of time. Of 118 patients included in the report, 90 were able to work, 20 were ambulatory, 5 remained under treatment, and 3 had expired. The period of observation since reinflation of the collapsed lung varied from one to eight years.

Anatomical changes following re-expansion of the lung showed that much resorption had taken place and that following healing there was a marked reduction in the amount of infiltration of the lung tissues. Except for the recurrences, the lesions in the re-expanded lungs, with the exception of 9 instances, remained unchanged since the time of complete re-expansion. In the 9 exceptions the residual fibrotic infiltrate either became calcified or showed further clearing as long as forty-eight months after re-expansion. WILLIAM E. ADAMS, M.D.

**Adams, W. E., Steiner, P. E., and Bloch, R. G.: Malignant Adenoma of the Lung.** *Surgery*, 1942, 11: 503.

This report deals with a particular type of tumor of the lung over which much controversy has continued. Two widely divergent opinions as to its proper management are prevalent at the present time. By one group of workers these tumors are considered benign and are treated by bronchoscopic removal. A second group classifies them as malignant and advises treatment by total pneumonectomy.

The marked variability in the clinical course of malignant tumors of the lung in general has helped to confuse an attempt at proper classification and correct management.

This is true especially with the group of cases under discussion. Clinically they behaved like benign tumors for months or years, giving rise to symptoms only by obstruction of the air passages. Ultimately they showed definite evidence of malignancy by involvement of the adjacent structures by direct extension and by distal metastases, although few or no mitotic figures were demonstrable.

A group of 5 cases of endobronchial tumor are reported which were characterized by a long clinical course and low-grade but very definite malignant manifestations. Differentiation of benign from malignant epithelial tumors of the bronchi is not possible from bronchoscopic biopsy material alone since this offers no criteria as to the amount of tumor invading the surrounding structures or as to the presence of distal metastases. This was very strikingly demonstrated in a critical examination of the gross and microscopic material of the 5 cases reported. Treatment must be based on the assumption that these tumors are malignant or potentially malignant, and they should be removed by lobectomy or pneumonectomy. Because of the relative degree of risk associated with these operations, lobectomy should receive preference when it is sufficient for removal of the tumor-bearing tissue.

In order that statistics of surgical cures of carcinoma of the lung may be more intelligently interpreted, sections for microscopic study should include the entire tumor. The group of tumors presented should not be confused with the highly malignant varieties.

The article contains detailed case reports accompanied by complete photographic illustrations of the gross and microscopic pathological conditions.

JOHN E. KIRKPATRICK, M.D.

**Lester, C. W., Cournand, A., and Riley, R. L.: Pulmonary Function After Pneumonectomy in Children.** *J. Thorac. Surg.*, 1942, 11: 529.

It has been demonstrated by Longacre, Carter, and their associates, that following pneumonectomy in dogs, there is a very definite variation in the resulting physical capacity of the animals, depending upon the age of the dog at the time of the operation. Following pneumonectomy on puppies, the functional

capacity under conditions of physical stress soon return to normal, but following the operation on adult dogs, the functional capacity is markedly diminished. It was found that the remaining lung in the puppy showed enlargement and histological evidences of growth, including increase in number and decrease in size of the alveoli. However, although the remaining lung in the adult dog was enlarged, the pathological sections showed evidence of emphysema, including enlarged alveoli with broken, overdistended walls.

This article is a report of the findings of 3 cases operated upon in childhood and studied while still in the period of growth. The first case was that of a girl nine years old. At the age of one year she had bronchopneumonia which was followed by bronchiectasis with persistent cough. Pneumonectomy was done in two stages, the lower lobe on the left being removed when the child was five years old and the left upper lobe being removed a year later.

The interval between operations was necessarily prolonged because of the contraction of diphtheria and then measles following the first operation. At the time of the writing of the article the child seemed to be entirely healthy. The second case was that of a boy twelve years old. He was admitted to Bellevue Hospital for tonsillectomy because of chronic productive cough. But routine examination followed by bronchograms showed bronchiectasis involving the entire left lung. Pneumonectomy was done when the child was ten years old. At the time of writing of the article the child's activities are not limited in any manner. The third case was that of a boy fourteen years old. He developed a lung abscess after whooping cough, which was adequately drained. However, following healing, an upper respiratory infection reactivated the abscess, and both lobes became involved. Pneumonectomy was done when the child was ten years old. At the time of writing of the article, the child's activities were not limited and clinically he was entirely well. In the first case, secondary operations were necessary to remove remaining pockets at the ends of open branch bronchi, and in the second and third cases, secondary operations were necessary for the treatment of complicating empyemas.

The following studies were made: (1) lung volumes, (2) maximum breathing capacity, and (3) ventilation, breathing reserve, respiratory gas exchange, and oxygen saturation of arterial blood, under basal conditions, during moderate exercise, during recovery from moderate exercise, and during exhausting exercise. Fifteen normal children, chosen so as to fall into three groups corresponding to the patients described as to age, height, weight, and body-surface area were also studied for purposes of comparison.

The technique of carrying out the tests and detailed description of the results obtained are presented in the article. The results of the tests for lung volumes showed that the remaining lungs in 2 of the patients were approximately the same size as the corresponding right lungs in the control group. In 1 case, however, the right lung was the size of both lungs in the control group. This was also demonstrated with x-rays. Maximum breathing capacities showed 2 patients to have 76 and 78 per cent, respectively, of the capacities of their controls, while the other patient had only 62 per cent of the capacity of his control. The last case is the same as the case described which had the increased lung volume. In the basal state, there was no important difference in the amount of ventilated air between the patients and the controls. However, the breathing reserves were less for the patients than for the normal children. All 3 children after pneumonectomy had smaller volumes of oxygen intake than their controls. In all 3 cases the percentage of oxyhemoglobin was within normal limits.

Following the institution of moderate exercise, the rates of ventilation were somewhat greater in the 3 cases studied than in the controls, but were still within normal limits. The breathing reserves were less in the patients and 1 case dropped below the threshold for dyspnea. The rates of oxygen intake were remarkably similar to those of the control group. Following recovery from moderate exercise, the amounts of ventilation were greater for the patients than for the controls. As in the tests before, the breathing reserves were less. The total oxygen intake and the total carbon-dioxide output were larger in the patients. The percentage of oxyhemoglobin in the arterial blood withdrawn immediately after exercise was normal in all 3 cases. During exhaustive exercise the volumes of ventilated air were well within the range observed in their control groups, except in 1 case in which the volume was smaller. Again the breathing reserve of the patients showed smaller values than was noted in the control groups. Oxygen intake and carbon-dioxide output closely corresponded to the normal. The efficiency of gas exchange was found to be excellent in all tests. The arterial blood withdrawn shortly after the cessation of the exhaustive exercise was normally saturated with oxygen in all 3 subjects.

It is worthy of note that 2 of the children studied showed better adaption to the physiological and anatomical changes following pneumonectomy than did the other one. This particular patient had an overdistended remaining lung. The mediastinum was not fixed, and allowed the right lung to distend into the left hemithorax. It is almost certain that there was emphysema present in this case, the physiology of which could readily account for the decreased efficiency of the lung as demonstrated by the tests.

This study compares favorably in its results with the results of the studies which have been done on dogs. It is very definite evidence of the ability of the compensatory mechanics of the respiratory and the cardiorespiratory systems to function in the event of lobectomy or pneumonectomy.

H. C. JERNIGAN, M.D.

## HEART AND PERICARDIUM

**Saphir, O., and Wile, S. A.: Myocarditis in Poliomyelitis.** *Am. J. M. Sc.*, 1942, 203: 781.

The clinical records and autopsy findings in the cases of 7 patients with poliomyelitis, who died either during the acute stage or some time after paralysis of various parts of the body had ensued, are reviewed. Four patients had bronchopneumonia; 6 patients showed evidence, at autopsy, of varying degrees of myocarditis, and the sudden death of 3 of them may be attributed to the myocarditis.

Myocarditis could have been suspected clinically in 3 patients who suddenly became worse without apparent cause coincidently with the occurrence of cyanosis and a rise in pulse rate. Histologically, the myocarditis was characterized by foci of perivascular infiltrations of lymphocytes and neutrophiles and foci of lymphocytes just beneath the endocardium. The inflammatory cells were never very numerous in any one area but they were present in many blocks cut from different parts of the myocardium.

WALTER H. NADLER, M.D.

## ESOPHAGUS AND MEDIASTINUM

**Stephens, H. B.: Cancer of the Thoracic Esophagus and the Upper End of the Stomach.** *J. Thorac. Surg.*, 1942, 11: 469.

The author reports his experiences with 23 cases of cancer of the esophagus and cardia following exploration or resection.

In 13 patients (Group I) the lesions were primarily in the esophagus and in 10 (Group II) they were primarily in the cardiac end of the stomach.

The operations performed were as follows:

In Group I: Torek resection, 8 (1 patient expired on the table); Garlock's modification, 1; resection with reanastomosis, 2; transthoracic exploration, 2.

In Group II: resection with reanastomosis, 5; Torek resection with removal of the proximal half of the stomach, 1; transthoracic exploration without resection, 2; gastrostomy alone, 1.

Of the 13 patients in Group I, 8 died within the first twenty-three days, chiefly of infection and shock. In 4 of these the condition had been inoperable. Of the remaining 5 patients, 4 expired in from two and one-half to ten months following operation from persistence of the tumor or from metastases. The fifth patient was living and well eleven months following a Torek resection.

Of the 10 patients in Group II, 4 died within from twenty-four hours to twenty-six days, from various causes; 3 died within from one and one-half to sixteen months following operation, from persistence of the tumor or from metastases, and the 2 remaining patients were alive one and four months, respectively, following operation; however, the condition in both of these cases had been inoperable.

In analyzing the statistics on these 23 cases, and excluding those cases which should have been called inoperable, the mortality rate following resection in the first group was 60 per cent, and in the second group, 83 per cent.

Important factors in the management of these cases included preoperative pneumothorax of the left pleural cavity, cyclopropane intratracheal anesthesia, and the use of the lower end of the esophagus instead of a gastrostomy (in patients having the Torek type of operation) for connection with the cervical stump.

The author presents experimental work in which a skin tube is fashioned from the anterior chest and upper abdominal walls for uniting the upper part of the esophagus with the stomach in those cases in which the entire thoracic esophagus must be removed. The upper end of the skin tube is later anastomosed with the cervical esophagus. This operation has been successful in animals, and it is to be tried in clinical cases. One point is made in regard to the reanastomosis of the esophagus with the cardiac end of the stomach; namely, that the esophagus be drawn beneath a small flap of serosa which is later used as a means of covering the suture line between it and the stomach.

WILLIAM E. ADAMS, M.D.

# SURGERY OF THE ABDOMEN

## ABDOMINAL WALL AND PERITONEUM

**Calcagno, B. N., and Casiraghi, S. C.: Biological Therapy of Echinococcosis. Hydatid Cyst of the "Ascitic Type"** (Terapéutica biológica de la equinococosis. Quiste hidatídico "a tipo ascítico"). *Bol. Acad. argent. cir.*, 1942, 26: 247.

The authors present this case of a forty-one-year-old man with a hydatid cyst of the ascitic type because such excellent results were obtained from biological therapy and also because this clinical variety of echinococcus is rarely seen. The patient gave a history of an acute abdominal attack occurring in 1929, which the authors believe was due to the rupture into the peritoneum of a hydatid cyst probably of hepatic origin. When the patient was first seen by the authors, he was complaining of gastric disturbances. The roentgenogram showed a frank pyloric obstruction. Physical examination revealed a large abdomen simulating great ascites with fluid and tension.

The patient was treated by vaccination with concentrated or simple hydatinous fluid. His general condition improved and his local symptoms were greatly relieved. A puncture was performed and clear fluid was first obtained, which later became thick and turbid. Peritoneoscopy was then performed and this revealed that the cyst was prevesical or preperitoneal rather than peritoneal.

Fig. 1.

The patient's condition first improved but later became worse. At this time the x-rays showed a large pyloric stenosis with marked distention of the stomach. Several months later the condition became worse and intestinal obstruction occurred; this necessitated laparotomy. An anterior gastroenterostomy was made. Exploration of the abdomen revealed a large cyst extending from the left hypochondrium to the iliac fossa and pelvis on the same side of the body.

Although the echinococcosis was cured, the patient continued to have intermittent attacks of diarrhea, left hypochondrial pain, and gastrointestinal distention. With rest, diet, and medication the condition improved but the pain continued.

MICHAEL DEBAKEY, M.D.

## GASTROINTESTINAL TRACT

**Barlow, D.: The Treatment of Cardiospasm by the Heller Type of Operation.** *Brit. J. Surg.*, 1942, 29: 415.

Cardiospasm is due to a disordered neuromuscular mechanism at or below the level of the diaphragm, the exact nature of which is uncertain, but which seems to be a condition of spasm rather than incoordination of the peristaltic wave. There is reason to believe that the lesion is congenital in origin. As a result of the primary obstruction, an esophagitis and lengthening and sagging of the esophagus occur. Any successful treatment must effectively and permanently overcome both this obstruction and its concomitant complications.

There seem to be several good methods of attack, all of which apparently have been followed by excellent results:

*Treatment by dilatation with bougies.* There is no doubt that a number of early or tolerant uncomplicated cases do well on routine dilatations, and although a complete cure may not follow, the patients are at least able to derive comfort compatible with normal life. Multiple bougies of an initial filiform type on up to the largest sizes may be safely and carefully used. Plummer has perfected an ingenious method which consists in swallowing a long length of twisted silk to which a catheter is attached. Water is then permitted to flow into the esophagus, which produces a hydrostatic bag. The water pressure is gradually exerted upon the cardia and is controlled by a manometer. From 20 to 30 feet of water pressure is generally thought to be safe and practicable.

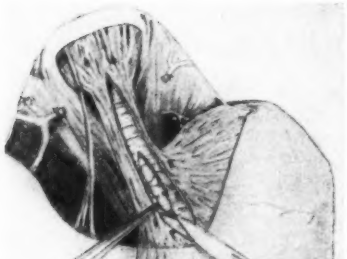


Fig. 1. Modified Heller's operation. Final stage.

*Treatment by operation.* This may be reduced to the Mikulicz digital dilatation through the open stomach, which has several disadvantages; or Barlow's modified Heller operation which consists in opening the abdomen through a left upper paramedian incision and manually drawing the stomach downward. A transverse incision 3 in. long is made through the left triangular ligament. The esophagus is freed by blunt dissection and the longitudinal muscles are split anteriorly. The thin circular fibers are then extremely carefully cut down to the esophageal mucosa, which begins to bulge outward. The incision should extend at least 2 in. on the esophagus and one and one-half in. on the stomach. If esophageal lengthening is required, it is sutured in position to the diaphragm. The abdomen is closed without drainage. A rapid and functional improvement usually results.

Barlow thinks the simplicity of the extramucous cardioesophagotomy, and the truly striking relief it brings to sufferers who have been uncomfortable for years should warrant its more general adoption.

STEPHEN A. ZIEMAN, M.D.

**Loubejac, A. M.: Strangulated Diaphragmatic Hernia of the Stomach** (Hernia diafragmatica estrangulada de estomago). *Arch. urug. med.*, 1942, 20: 138.

The author presents a case of strangulated diaphragmatic hernia of the stomach which was diagnosed preoperatively from roentgenograms. The patient was a thirty-two-year-old man who, two days before admission, was awakened in the morning by copious alimentary and bilious vomiting followed a few hours later by sudden continuous pain in the upper left quadrant of the abdomen and at the base of the corresponding hemithorax. There was also great respiratory difficulty. Three years before admission the patient had been operated on for a strangulated subdiaphragmatic hernia and one year before an appendectomy had been performed.

Examination of the abdomen revealed no distention and normal respiratory excursions. Pressure on the epigastrium and spleen produced pain. The clinical picture and the absence of occlusive phenomena suggested the diagnosis of strangulated subdiaphragmatic hernia which was confirmed by the roentgenograms which showed a gaseous circle with a liquid level above the left half of the diaphragm. The patient was operated upon with excellent results.

MICHAEL DEBAKEY, M.D.

**Pollard, H. M., and Cooper, R. R.: Is There a Clinical Syndrome Characteristic of Hypertrophic Gastritis?** *J. Michigan M. Soc.*, 1942, 41: 473.

Eight hundred gastroscopic examinations were made at the University of Michigan. Of these nearly 25 per cent revealed the typical morphological characteristics of hypertrophic gastritis. Fifty of the group of cases were selected and analyzed by the authors because the patients were entirely free of any other evidence of organic disease. This was done to determine the value and importance of gastroscopy.

The chief complaints were: burning epigastric pain (52 per cent), epigastric fullness (16 per cent), dull epigastric pain (14 per cent), substernal burning (12 per cent), vomiting (6 per cent), right upper-quadrant pain (6 per cent), gnawing epigastric pain (4 per cent), paraumbilical pain (2 per cent), and severe sharp epigastric pain (2 per cent).

The symptoms were: abdominal pain (88 per cent), ructus (52 per cent), nausea (50 per cent), vomiting (32 per cent), nocturnal pain (32 per cent), substernal burning (30 per cent), hematemesis (24 per cent), tarry stools (20 per cent), and anorexia (16 per cent).

The time of the onset of pain was: from one to two hours after food (32 per cent), immediately after food (22 per cent), after meals (8 per cent), not related to meals (16 per cent), before meals (12 per cent), and constant (2 per cent).

The causative agents of pain were: fatty and fried foods (14 per cent), exertion (10 per cent), alcohol (8 per cent), emotional upset (8 per cent), citrus fruits (4 per cent), tomatoes (4 per cent), coarse foods (2 per cent), pickles (2 per cent), rapid intake of water (2 per cent).

Gastrointestinal roentgenograms and cholecystograms were obtained and were found to be entirely negative in 46 of these 50 patients. Stool examinations showed occult blood in 34 patients. Gastric analysis was done for 36 patients (0.5 mgm. of histamine acid phosphate was given subcutaneously to stimulate gastric secretion and acidity); 21 showed maximal free hydrochloric acid over 50 degrees; 13 of these 21 showed more than 80 degrees of free acid. Fifty-six per cent of the toal group showed no free acid in the fasting specimen. None of the 36 patients had complete achlorhydria.

The treatment was empirical since the causes of the conditions were not known: bland diet; aluminum hydroxide for its demulcent effect; silver proteinate (2 per cent solution) t.i.d. before meals, or in the form of lavages with silver nitrate in from 1:1500 to 1:3500 dilution after tap-water lavage and followed by saline lavage, on consecutive mornings in the fasting state. Some x-ray treatments were given, but these are still in the experimental stage and cannot be recommended indiscriminately even though some beneficial results were recorded.

The authors' studies disclosed that direct gastroscopic examinations will reveal hypertrophic gastritis when other laboratory tests are negative. The feature directing attention clinically to this condition is a burning sensation or epigastric discomfort. This may appear immediately before or after eating or may be delayed one or two hours. At times the symptoms are relieved by food or soda. Free acids in normal or increased amounts are commonly found during these tests. Finding hypertrophic gastritis gastroscopically enables the physician to treat and guard the patient against small or massive gastric hemorrhage which may occur—as evidenced by occult blood in the stool. The diagnosis of hypertrophic gastritis gastroscopically depends upon finding typical "cobblestone" or "orange-peel" areas in the gastric mucosa; enlarged and hypertrophic rugal folds, dull orange-red in color with diminished highlights; an excessive amount of mucus adhering to the mucous membrane; superficial erosions; and occasional fresh hemorrhagic areas.

Prominent rugal folds were demonstrated with x-rays in only 1 of these cases.

While no characteristic clinical syndrome is typical of hypertrophic gastritis, the authors believe this condition *per se* can be the sole cause of gastric symptoms and therefore deserves consideration in a study of differential diagnosis. They state definitely that the diagnosis must be made by exclusion and, finally, by means of the gastroscope.

MATHIAS J. SEIFERT, M.D.

**Edberg, E.: On the Treatment of Acute Intussusception in Children.** *Acta chir. scand.*, 1942, 86: 369.

The clinical aspects of acute intussusception in children were quite manifest long before the roentgen epoch, and yet the x-ray examination of these cases has been of immense importance. The diagnosis has become more detailed and the application of a contrasting fluid by means of a pressure enema, while diascoping during narcosis, is now a treatment that has to a great extent replaced laparotomy. The pressing enema recommended by Hirschsprung is now enjoying a new vogue in a modernized form.

During the past ten years, the writer has treated 80 patients for acute intussusception or if they were suspected of having this condition. In 11 instances, it was impossible to prove the diagnosis, in spite of the fact that the anamnesis was striking. The diagnosis of 69 cases was fully established and, in most instances, verified by good x-ray plates. Contrasting pressure enemas were regularly employed and this method proved successful in 38 per cent of the patients. In 66 cases, the intussusception was located in the ileocecal region.

Three different types are distinguishable in this region, namely: the cecoileocolic, the ileoileocolic, and a combined type. The latter begins in the lowest part of the ileum and obstructs the passage into the cecum. The intussuscepted ileum together with the valve of Bauhin form a combined caput. The first and third type should preferably be treated by means of pressing enemas. The ileoileocolic type should be operated upon at once. Although it is often possible to disinvaginate, at least partially, and fill the entire cecum with contrasting fluid, one cannot be certain whether the ileum has been effectively dealt with.

Eleven patients had relapses. These 11 children were treated 28 times for acute intussusception, 15 times by means of pressure enemas only, and 13 times by laparotomy. It was obvious that the combined type of intussusception showed the majority of relapses. It seems likely that with a greater experience in the details of diagnosis, we shall be able to improve the results of the treatment of this still very dangerous childhood disease.

JOHN W. NUZUM, M.D.

**Cattell, R. B.: Closure of the Ileostomy in Ulcerative Colitis.** *Ann. Surg.*, 1942, 115: 956.

The surgical treatment of ulcerative colitis has been a recent development, and it is now accepted that good results follow the employment of ileostomy, partial colectomy, and total colectomy. In spite of improvement in the surgical treatment there has been no general acceptance of definite indications for ileostomy, or uniformity in the time that ileostomy has been elected.

Cattell recommends early ileostomy in severe ulcerative colitis and outlines the indications for ileostomy as (1) acute fulminating cases, (2) medical failures, (3) massive hemorrhage, (4) subacute perforations, abscesses, peritonitis, or fistulas, (5) obstruction, and (6) polyposis and possible malignancy.

Three factors are considered for closure of the ileostomy, (1) clinical remission of the symptoms should be maintained for an appreciable period; (2) the inflammatory process must be shown to have healed and be inactive; and (3) the colon must be distensible by means of a barium enema or double contrast-air enema.

Cattell has closed the ileostomy in 9 patients since 1935. There was no operative mortality in this group. Clinical remission was obtained in all 9 of these patients, who were seriously ill. Two patients have had complete relief from their disease. Three patients had a mild recurrence and with further medical treatment have remained well. Two patients have continuing bowel symptoms, without fever, but they are able to work. Two patients had a complete failure and have had a new ileostomy.

Any patient who is not doing well on medical treatment and continuing to lose weight, run fever, and have excessive stools should have an ileostomy. Patients with the acute fulminating form of the disease who do not respond to medical management within the first five or seven days should have an ileostomy. Early ileostomy should be done in order to obtain the earliest possible remission before irreversible structural changes in the colon occur. It is in this type of case that later closure of the ileostomy can be considered. EARL GARSIDE, M.D.

**Jennings, J. E., Burger, H. H., and Jacobi, M.: Acute Appendicitis—A Clinical and Pathological Study of 1,680 Consecutive Cases.** *Arch. Surg.*, 1942, 44: 896.

This report is based on 1,680 consecutive cases of acute appendicitis confirmed by pathological evidence at the Beth-El Hospital, New York City, between the years 1930 and 1938, inclusive. The total mortality rate in this series was 1.9 per cent.

The age and sex incidence, the symptoms and signs, the laboratory data, the complications, and the causes of death in these cases are discussed.

In cases with mural lymphangitis and arteriophlebitis as complications, the morbidity and mortality rates were lower than in cases without these complications. Delay in operation and catharsis, both, were important factors in raising the mortality rate. Preoperative chills were not found to be of serious prognostic import.

Particular emphasis is laid on the value of the McBurney incision. Even in cases in which acute appendicitis is only suspected and the diagnosis is uncertain, the advantages of this incision, with a secondary incision on recognition of the error in diagnosis, are pointed out.

The authors also discuss the factor of fatigue on the part of the surgeon and on the part of the patient. It is suggested that night operations be postponed until morning in the absence of signs of spreading peritonitis in order to overcome this factor, and to adjust the disturbed electrolyte balance of the fluid of the patient. EDWARD W. GIBBS, M.D.

**Bowers, R. F.: Surgical Treatment of Malignant Lesions of the Sigmoid—with Extension.** *Ann. Surg.*, 1942, 115: 986.

The operability of malignant lesions of the sigmoid is limited by the presence of distant metastases. Extensive involvement of the adjacent structures also limits the degree of operability. The necessity for the resection of areas of small bowel, uterus, tubes, and ovaries with the sigmoid has been met successfully and is not regarded as particularly dangerous. When, however, the tumor invades the urinary bladder—especially if it is extensive or happens to be near the trigone—operation has been approached in a spirit of defeatism.

A redundant sigmoid colon is one which attaches itself to the bladder, and, therefore, allows extension of its tumors into the bladder. If no redundancy is present, the sigmoid usually lies against the posterior abdominal and pelvic walls, which position reduces the possibility of extension. The redundancy may be an asset if resection is to be performed.

The employment of preliminary colostomy and prophylactic sulfonamide therapy, together with the other preoperative agents, is recognized in the preparation of these patients for operation. The author presents 6 cases of cancer of the sigmoid with bladder involvement at the time of operation. It is suggested that neoplastic involvement of the bladder is no reason to withhold the radical operation from these patients. Partial resection of the urinary bladder may be accomplished without significant danger to the patient or resultant malfunction of the genitourinary system. The operation of total cystectomy, seminal vesiculectomy, and prostatectomy, combined with resection of the sigmoid neoplasm *en bloc*—if such is essential to effect a cure—is demonstrated to be possible.

Whether or not the patient with bilateral ureterostomies and permanent colostomy is one whose life in such a state is a fair exchange for death from cancer of these organs cannot be decided with accuracy until many similiar cases are recorded.

JOHN W. NUZUM, M.D

**Shackelford, R. T., and Weinberg, J. A.: The Treatment of Lymphogranulomatous Strictures of the Rectum with Short-Wave Diathermy.** *Am. J. Surg.*, 1942, 57: 83.

An attempt is made to evaluate the use of diathermy in the treatment of lymphogranulomatous strictures. Almost every form of chemical, biological, radiological, electrical, surgical, and physical treatment has been used without very promising results after the secondary manifestations of lymphogranuloma venereum have developed.

The authors used a short-wave machine and applied a metal plate to the abdomen. The plate was connected to one pole of the machine and the other pole was connected to a Hegar dilator which was inserted into the strictured area. The largest dilator that could be inserted without causing the patient too much discomfort was used. Treatments were given from two to six times per week for a period of twenty minutes each, as much current being used as the patient could tolerate. Five patients were treated in this manner and 2 patients were used as controls. In the controls similar Hegar dilators were inserted in a similar manner for periods of twenty minutes each but no diathermy was used.

All 5 of the patients treated showed local and symptomatic improvement at the conclusion of the course of dilatations. In 1 a rectovaginal fistula healed and has not recurred. In another a rectovaginal fistula persisted unchanged. Three to six months after the treatment ceased the strictures had recontracted to some extent in all 5 of the patients treated.

From these facts the authors conclude that diathermy treatment *per se* to rectal strictures of lymphogranulomatous origin offers very little if any

curative effect. They believe that whatever benefits did result were primarily the effect of more frequent and prolonged dilatations than were used in the past. HAROLD LAUFMAN, M.D.

## LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

**Long, H.: Observations on the Choledochoduodenal Mechanism and Their Bearing on the Physiology and Pathology of the Biliary Tract.** *Brit. J. Surg.*, 1942, 29: 422.

Biliary dyskinesia is recognized as a motor dysfunction which may be responsible for typical symptoms of gall-bladder disorder, yet the patient will present at operation an apparently normal biliary tract. Alternately, the symptoms may appear as a delayed postoperative complication of a cholecystectomy. Recent clinical research has proved that biliary dyskinesia is the result of spasm about the lower end of the common bile duct with the resulting rise of pressure and distention in the biliary passage. The exact site of the spasm, however, the cause of its onset, and its relationship to the pathological processes in the biliary system have not been satisfactorily explained.

To clarify these problems, Long surveyed the literature on the anatomy and applied physiology of the common duct at its opening into the duodenum. Although it has been shown anatomically that an independent "sphincter of Oddi" is demonstrable, yet physiologically the presence of an independently active sphincter has never been shown conclusively. The difficulty has always been to differentiate any pure sphincteric effect from the effect caused by the strongly active duodenal wall.

On a series of 53 dogs, it was shown that the choledochosphincter and the muscular coat of the duodenal wall usually contract together. On the other hand, it was likewise demonstrated that the choledochosphincter can act independently of the activity of the duodenal wall, a fact that Long claims has never been demonstrated conclusively before, from a physiological standpoint.

To discover the stimulus which may be responsible for this independent action of the sphincter, Long designed a simple apparatus for perfusing fluid through the common bile duct into the duodenum and for measuring the resistance offered to the flow of fluid by the choledochoduodenal mechanism. The tracing of a normal dog is presented and the effects of administering morphine in considerable doses is recorded. Tracings are likewise given showing the effects of antispasmodic drugs, such as atropine and syntropan, after the subcutaneous injection of morphine. Studies of amyl nitrite, sodium nitrite, introduced into the stomach and into the perfusing fluid, as likewise of minimal doses of acetyl choline with adrenaline were also made. Finally, the effects of introducing bile into the perfusing fluid, and the importance of the pH of the bile and the concentration of the bile salts in relation to the working of the choledochosphincter were demonstrated.

The conclusion is drawn that biliary dyskinesia is merely one manifestation of the earliest stage of changes that occur because of a back pressure of bile in the biliary tract. Pain from spasm of the sphincter, which will not allow the strongly contracting gall bladder to empty itself, results. Nausea and vomiting follow the distention of the biliary passage, and there is a temporary decrease in the production and output of bile salts either concomitant with or following a temporary derangement of the liver. The same sequence may occur after cholecystectomy. STEPHEN A. ZIEMAN, M.D.

**Andrus, W. DeW., Lord, J. W., Jr., and Lake, M.: Tests of Hepatic and Pancreatic Function in the Differential Diagnosis and Preparation of Patients with Lesions of the Biliary Tract.** *Ann. Surg.*, 1942, 115: 1015.

Clinical and experimental studies indicate the vital role of the liver in the formation of prothrombin. The plasma prothrombin level is depressed in patients with hepatic disease and, under such circumstances, the response to Vitamin K therapy is inadequate or absent. These facts suggested the use of the plasma-prothrombin level and its response to Vitamin K as an index of liver function.

The authors have studied the application of the plasma-prothrombin level and its response to 2-methyl-1, 4-naphthoquinone given intramuscularly, as a measure of liver function in 86 cases since October, 1939. The parenteral route of administration was used to exclude instances of defective absorption from the intestinal tract. The thesis was adopted that if the plasma-prothrombin level was below 80 per cent in a given case, it was an index of the performance of the liver, while the response to 2 mgm. of 2-methyl-1, 4-naphthoquinone administered intramuscularly indicated whether depressed function was, or was not, due to organic liver disease.

The method was compared with the galactose-tolerance, hippuric-acid, and bromsulfalein-clearance tests in 3 groups of selected cases: Laennec's cirrhosis of the liver, catarrhal jaundice, and obstructive jaundice (extrahepatic) due to a variety of lesions. Results showed that the bromsulfalein test was the least sensitive, the hippuric-acid test was next in accuracy, and the galactose-tolerance and plasma-prothrombin tests were most sensitive.

Differentiation between obstructive jaundice of intrahepatic and of extrahepatic origin is frequently possible, as in the latter the liver is usually undamaged. Conflicting reports have been published about the efficacy of the galactose-tolerance test and the cephalin-cholesterol-flocculation test for this purpose. By combining the use of the response of the plasma-prothrombin level to menadione given intramuscularly, and a study of the amount of pancreatic ferments in the duodenal contents, the authors were able to localize some of the lesions causing obstructive jaundice with a high degree of accuracy.

Experimental and clinical studies of many workers on the protection of the liver against hepatotoxic agents are discussed, including some of the authors' own animal experiments. These facts may be summed up as follows:

Any factor which diminishes the exposure of the individual to the toxic agent (chloroform, carbon tetrachloride, phosphorus, arsphenamine) will decrease the amount which reaches the liver.

Any factors which lower the lipid content of the liver tend to diminish the amount of toxic agent held in the liver. Thus, a high caloric, high protein, high carbohydrate, and low fat diet is very important. Protein displaces fat, carbohydrate spares protein and displaces fat to a lesser extent, and choline decreases liver fat.

All factors tending to spare the oxidation-reduction system of the cells, as the SH group of certain amino acids, such as cystine and methionine, may exert a protective action. Anemia or anesthetic agents associated with relative anoxia exert a deleterious effect, while oxygen therapy is therefore valuable in such cases.

Abundant protein enhances liver regeneration, and choline and xanthine aid this process by clearing fat from the injured organ.

Unknown B complex factors probably exert some specific action on the hepatic cell, the nature of which is not yet understood.

S. Lloyd Teitelman, M.D.

## MISCELLANEOUS

**Ryan, J. D., Bauman, E., and Mulholland, J. H.: Blood Concentration and Urinary Excretion of Sulfadiazine Following Intraperitoneal Administration.** *J. Am. M. Ass.*, 1942, 119: 484.

The rate of absorption of a single dose of sulfadiazine by the peritoneum was studied in 6 surgical cases. In these cases the concentration of free and total sulfadiazine in the blood and urine was determined at intervals of six hours for a period of about seventy-two hours after its intraperitoneal administration. Fluid intake was controlled and the output measured.

Sulfadiazine was absorbed rapidly from the peritoneum and reached a maximum concentration in the blood in from twelve to thirty-six hours. Effective levels of sulfadiazine in the blood persisted for forty-eight hours after the deposition of 10 gm. of the powder in the peritoneal cavity. Larger amounts of the drug (20 and 25 gm. in the peritoneal cavity) tended to greater concentrations of sulfadiazine in the blood and urine. Sulfadiazine in the urine paralleled the concentration in the blood, but the acetylated fraction of the sulfonamide usually averaged 30 per cent of the total drug concentration. Although significant amounts of sulfadiazine were absorbed into the blood, the local concentration of the drug in the peritoneum remained potent and effective longer than sulfanilamide, which is absorbed by the peritoneum very rapidly. In this series, no toxic manifestations of sulfadiazine were observed. Benjamin G. P. Shafiroff, M.D.

**Singleton, A. O., Rogers, F., and Houston, F. G.: The Problem of Intestinal Gases Complicating Abdominal Surgery.** *Ann. Surg.*, 1942, 115: 921.

Prevention of gaseous distention following operations is easier than the relief of such distention after it has developed. The authors have used the following plan to prevent such distention:

A Levin tube is put in place just before the anesthetic is started and allowed to function throughout the operation and until peristalsis has been restored. The tube is kept open by drinking water which the patient enjoys to the extent of tolerating the tube. In from twenty-four to forty-eight hours the tube is clamped for three hours and the water which is taken by mouth is measured. Suction is then restarted and the returned fluid measured. If little of the fluid is recovered, it is believed that peristalsis has returned and the tube is removed. If all of the fluid is returned, suction is continued. In complicated cases, such as peritonitis or intestinal, gastrointestinal, and gastric resections, suction is continued for seventy-two hours or longer if necessary.

Gastric suction as outlined prevents postoperative distention and all of the evil effects of distention. The stomach is empty when the abdomen is opened and remains empty after operation, which prevents postoperative vomiting. Wound healing is more satisfactory and there is a lowering of morbidity and of mortality in the absence of distention.

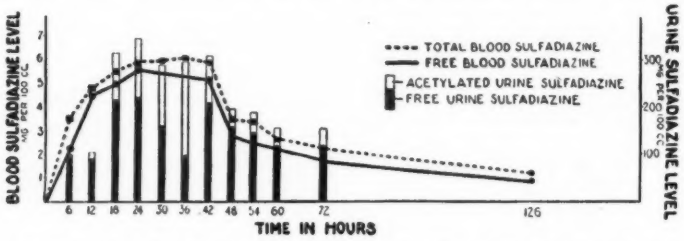



Chart 1 (case 2). Blood sulfadiazine level and urine sulfadiazine level, in a patient with carcinoma of the stomach with partial gastrectomy; 10 gm. of sulfadiazine powder were given intraperitoneally.

A distinction should be made between gastroduodenal and gastric suction. The fluid loss by suction, when the tube extends into the duodenum is considerably more than when the tube extends only into the stomach. With the tube in the stomach many patients show little or no bile in the suction fluid. The loss of fluids and electrolytes, in the form of bile, pancreatic juice, and chlorides from the stomach is cared for by preoperative and postoperative attention to the fluid and electrolyte balance in accordance with the principles established by Coller and his associates. The annoyance of the tube to the patient is counterbalanced by the elimination of vomiting, pains, enemas, and the discomforts that accompany distention. The value of this procedure is particularly noticeable in acute inflammatory intra-abdominal conditions, as well as in intestinal obstruction. Ileus is of little consequence in the absence of gaseous distention. In advanced peritonitis one can more safely wait for a favorable time for operation by using gastric suction and preventing further distention. If the patient with advanced peritonitis be operated upon, the prevention of distention following operation guarantees rest of the bowel and maintenance of good intestinal circulation, and aids the protective power of the peritoneum to overcome infection.

Gastric suction is indispensable in the very large abdominal and diaphragmatic hernias in which the intestines have been outside of the abdominal cavity for a long time, with marked reduction in the size of the cavity. Forcing the hernial contents back into the abdominal cavity and closing the wound under tension is possible. Keeping the bowel deflated for several days until peristalsis is restored makes this procedure safe. In operations upon the stomach, intestines, colon, or rectum, and more particularly when stomach and intestinal suturing is done, elimination of distention for several days makes enterostomies proximal to anastomoses unnecessary.

In the discussion GATCH stated that patients often swallow great quantities of air in the induction period of anesthesia. The resulting dilatation of the stomach offers a serious impediment to respiration, which may be fatal in some cases. When the capacity of the thorax is decreased by elevation of the diaphragm, the lungs are incapable of oxygenating the blood completely and this inability cannot be overcome even by the administration of pure oxygen. It, of course, follows that anesthesia is made much safer by deflation of the stomach.

COLLER said that enemas do nothing but exhaust the patient, stimulate reverse peristalsis, and increase distention, while the rectal tube does nothing but cause piles. Prevention of distention makes enemas and the rectal tube unnecessary.

TRUESDALE said that when the pressure in the stomach has become greater than the pressure in the left pleural cavity, the diaphragm rises until it is in position of eventration. In this position it displaces the heart and the entire mediastinum and causes pressure on the right lung. As the pressure increases, the right lung is encroached upon further, and there is an anoxemia. The stomach tube will empty the stomach, even when the displacement of the thoracic organs has developed to a considerable degree. The Miller-Abbott tube is not as effective as the straight stomach tube under these circumstances.

MADDOCK stated that while distention has been attributed to swallowed air, the exact mechanism of the entrance of this air into the intestines has not been adequately explained.

MANUEL E. LICHTENSTEIN, M.D.

# GYNECOLOGY

## UTERUS

**Dahl-Iversen, E., Hamburger, C., and Jorgensen, H.: Cystic Glandular Hyperplasia of the Endometrium Elucidated by Therapeutic Experiences in Patients and by Experiments on Rhesus Monkeys.** *Acta obst. gyn. scand.*, 1942, 21: 215.

The authors have made a survey of the works published since 1937 on the treatment of cystic glandular endometrial hyperplasia with curettage and with gonadotropin preparations.

The therapeutic experiences have shown that it is not practicable definitively to cure the more severe cases of cystic glandular endometrial hyperplasia in young women by stimulation therapy, even with doses of from 36,000 to 42,000 I. U. of chorionic gonadotropin. This treatment gives merely a temporary regulation of the menstruation, and thereafter a relapse appears. Further treatment with a similar or larger dose of chorionic gonadotropin does not protect against a new relapse.

According to the therapeutic experiences, there appears to be no essential difference between substitution therapy and stimulation therapy, for it looks as if it is not possible to interfere with the unknown disturbances that give rise to endometrial hyperplasia. In a juvenile case, folliculin had no effect whatever, neither therapeutic nor prophylactic against relapse.

The pathogenesis of cystic endometrial hyperplasia is unknown.

The experiments reported have confirmed the fact that the gonadotropins which have been employed in the treatment of cystic glandular endometrial hyperplasia in man (chorionic gonadotropin and mare's serum gonadotropin) are able to produce nonphysiological changes in rhesus monkeys, but even after intensive treatment these changes are merely temporary. Some time after the discontinuance of the treatment the ovaries resume a perfectly normal function (3 cases).

In rhesus monkeys it is not practicable, as it is in guinea pigs, to produce cystic glandular endometrial hyperplasia by subtotal resection of the ovaries, as the ovarian remnant in the 2 monkeys employed for this experiment regenerated rapidly and functioned like a normal ovary.

Autotransplantation of the ovaries to the labia majora—which in the woman may give rise to cystic glandular endometrial hyperplasia and follicular cysts in the ovary—was followed in 1 monkey merely by atrophic changes in the vaginal epithelium, endometrium, and ovaries; in particular, there were no follicular cysts in the ovaries.

The administration of estrogenic substances (estradiolbenzoate and diethylstilbestrol) to monkeys for a sufficient length of time may produce some changes in the endometrium that have some morphological resemblance to cystic glandular endometrial hyperplasia in man (3 cases). These changes do not represent the disease called cystic glandular endometrial hyperplasia, however, as the symptoms characteristic of this lesion (hemorrhages and areas of necrosis) are absent. Besides, these changes subside again and give place to normal structures when the administration of estrin is discontinued.

HARRY W. FINK, M.D.

## ADNEXAL AND PERIUTERINE CONDITIONS

**Danforth, D. N.: The Cytological Relationship of the Walthard-Cell Rest to the Brenner Tumor of the Ovary and to the Pseudomucinous Cystadenoma.** *Am. J. Obst.*, 1942, 43: 984.

Walthard rests are a common finding in the normal fallopian tube. They occur less commonly in the ovary.

Walthard rests and Brenner tumors bear a strong resemblance to one another, not only in intrinsic architecture, but also, and more especially, in nuclear detail. The basic nuclear type of each is readily identifiable by the presence of a median groove or fold. The deviations from this basic type are described. Though by no means limited to the tissues in question, this nuclear peculiarity is sufficiently constant to be regarded as a fundamental characteristic of both the Walthard rest and the Brenner tumor. Furthermore, its presence in both structures appears to strengthen the hypothesis that these growths may be derived from the same tissue. The similarity of this nucleus to that of the testicular Sertoli cell is worthy of note.

The presence of the basic nucleus in many pseudomucinous cystadenomas is of interest in considering the possibility that a small proportion of these tumors may be derived from Brenner-cell rests.

EDWARD L. CORNELL, M.D.

## MISCELLANEOUS

**Martin, C. L.: Fallopian-Tube Visualization as a Treatment for Sterility.** *Am. J. Roentg.*, 1942, 47: 894.

Tubal obstruction, according to various authorities, accounts for female sterility in from one quarter to two-thirds of all patients examined. Simple spasm may be a factor, but in the author's experience granulation tissue and fibrosis are usually present. He reviews the development of fallopian-tube visualization and its value, as well as the methods used for demonstrating patency. Following the satisfactory visualization of the tubes with iodized oil, it became evident that closed tubes might be opened with oil.

The author describes his technique in detail. Carbon-dioxide gas is first used to demonstrate the patency of the tubes. If nonpatent, 5 cc. of lipiodol are injected and a roentgenogram is made. If this re-

veals that the oil is not passing completely through the tubes, a second exposure is made following the injection of an additional 2 cc. of lipiodol. If the tubes are not completely filled following this procedure, it is repeated as often as progress can be demonstrated. The increased uterine pressure is maintained throughout the entire test by closing the valve at the end of the cannula after each injection.

It is the author's opinion that the slowly increasing oil pressure is more effective in opening up adhesions than the repeated application of gas pressure for short periods of time. When the uterus and cervical canal show dilatation and the heads of the oil columns in the tubes do not advance following one of the fractional injections, the test is abandoned. However, a subsequent roentgenogram is always made twenty-four hours later because the peristalsis in the tubes will sometimes force the oil into the peritoneal cavity after the pressure has been released.

Among 101 sterile women examined by the combined technique described, patency of at least one tube was established in 75 and conception occurred later in 27, or 36 per cent of the women in this group. The successful cases are tabulated. Normal pregnancies ensued in all but 1 patient. In this woman no patency could be demonstrated, but ectopic gestations occurred first in one tube and then in the other at periods of two and one-half and three years after the test was carried out. Patency was established at the first visit in 20 cases, but 2 tests were performed in 4 patients and 3 tests in 3 others. The ultimate success obtained in cases in which multiple examinations were done makes it seem likely that the figures could have been improved if more patients had subjected themselves to repeated tests. Conception occurred within eight months after the test in all except 4 patients. In 17 of the 27 women who became pregnant, lipiodol was forced through the tubes by the slow pressure method after the carbon-dioxide method had failed.

Possible complications as reported in the literature are given consideration. No mishaps have occurred in the author's experience. Contraindications to the use of the method are also discussed briefly. Of these, acute and subacute pelvic inflammations are the most important. The percentage of pregnancies following patency tests reported by others are tabulated.

The following conclusions are drawn:

1. Patency of at least one fallopian tube can be produced in about three-fourths of all women with blocked tubes by using a combined carbon-dioxide and lipiodol technique.

2. A normal pregnancy can be expected in about one-third of the cases in which such patency is established.

A. HARTUNG, M.D.

**Genitis, V. E., and Bronstein, I. P.: Pregnandiol Excretion in Female Pseudohermaphroditism.** *J. Am. M. Ass.*, 1942, 119: 704.

Pregnandiol is the end-product of progesterone metabolism and is excreted in the urine during the luteal phase of the normal menstrual cycle in a daily output of from 2 to 10 mgm. During pregnancy this compound is excreted in increased quantities, which may be as much as 75 mgm., and a dimunition during gestation is indicative of some pathological condition. The authors reported their findings of pregnandiol excretion in 2 pubescent pseudohermaphrodites.

The first case was that of a ten-year-old child with a skeletal age in excess of the chronological age presenting masculine characteristics and a large phallic structure demonstrating a urethra and vagina. No testes were demonstrable but a uterus was outlined by iodized-oil studies. Pregnandiol excretion was found to range from 0.38 to 19.7 mgm. in forty-eight hours. An exploratory laparotomy was refused and the parents placed the child in a school for boys where he experienced psychological improvement.

The second case was that of a four-year-old child born a girl who presented at delivery an enlarged clitoris. The bone age was estimated at twelve years. Exploratory laparotomy demonstrated the internal genital organs to be those of a female. Ovarian section demonstrated an increased stromal density surrounding the follicles which had reached the stage of development of early puberty and presented evidence of atresia. Pregnandiol determinations showed variations; however, in some forty-eight-hour specimens 20 mgm were recovered. A section of the adrenal gland showed the presence of an adenoma.

The authors mention another case in which the internal organs were feminine and the single preoperative pregnandiol determination was found to be 36.2 mgm. in twenty-four hours. This patient demonstrated microscopic evidence of adrenal hyperplasia on resection of the adrenal gland.

It was pointed out that the presence of pregnandiol in pseudohermaphroditism has not heretofore been investigated, except in the case of a three-year-old child reported by Stover and Pratt, and in this case no increase in the compound was found. It is suggested that since this substance is elevated in hermaphroditism an adrenal factor may be responsible because of the close relationship of the structure of progesterone, androgen, cholesterol, and desoxycorticosterone. However, it is pointed out that additional pregnandiol determinations will be necessary before normal ovarian function at puberty can be gaged.

ROBERT LICH, JR., M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

**Kawerau, E.: The Capillary Permeability Test in Pregnancy.** *Irish J. M. Sc.*, 1942, No. 194, 58.

The author describes the method of performing the capillary permeability test in pregnancy as follows:

Apply a sphygmomanometer cuff at the ordinary level of the upper arm. Raise the cuff pressure to 10 mm. of mercury above the diastolic blood pressure of the patient, and maintain it at this level for at least twelve minutes, but not longer than fifteen minutes. A circular opening of 1 in. is cut from a piece of thin black cardboard which is applied to mask off the area at which punctate hemorrhages have appeared. The maximum number of spots found within this circle is counted. If more than 15 are seen, the test indicates abnormally decreased capillary permeability.

By this method a total of 455 individuals, representing six different groups, were tested: Group I consisted of 43 college students from eighteen to twenty-one years of age. Group II consisted of 48 students resident at the Rotunda Hospital and engaged in practical midwifery in the district. The individuals in these groups were considered to be on well balanced diets. Groups III to VI, inclusive, consisted of the poor extern or intern patients of the Rotunda district. The diet of these women may have contained only half the amounts required in the dietary scheme for the pregnant and nursing woman as proposed by the Health Committee of the League of Nations. Group III consisted of 47 intern patients during their confinement; these had borne live babies. Group IV consisted of 31 extern patients who had aborted. Group V consisted of 186 patients attending the antenatal clinic during the period from April to May, 1940, and Group VI consisted of a similar group of 100 patients attending the clinic during the month of July, 1941.

It was shown by this test that the pregnant women and the women who had aborted showed a tendency to suffer from abnormal capillary permeability which was from three to four times greater than that of the ordinary normal adult (Group I).

The test cannot be used for patients who suffer from a high diastolic blood pressure; for this reason the toxemic conditions of pregnancy could not be investigated to any extent.

Ninety per cent of the pregnant women suffering from iron-deficiency anemia exhibited well marked abnormal capillary permeability.

There was no evident relationship between capillary permeability and gingivitis (bleeding).

The suggestion was made that the test should be of great value in determining rapidly the adequacy or inadequacy of a person's nutritional state. This seems to be a reasonable thing to do if one keeps in mind the many arguments which point to the possibility that more than one food factor is responsible for the maintenance of capillary health. However, the author believes that Vitamin C plays the most important role in the maintenance of a normal capillary permeability. The role of Vitamin P is undecided.

DANIEL G. MORTON, M.D.

**Bickerstaff, H. J.: The Relationship Between Late Prenatal Hemoglobin Levels and Febrile Puerperal Morbidity.** *Am. J. Obst.*, 1942, 43: 997.

Records of 2,018 consecutive multiparas, with normal term pregnancies and spontaneous home or hospital deliveries, are reviewed. Conditions of trauma, infection exposure, and handling were reasonably homogeneous for the group.

Hemoglobin determinations, within four weeks ante partum, were available in 1,001 cases. A marked, almost uninterrupted, decline of the incidence of febrility, with increasing values of hemoglobin, is reflected throughout various tabulations by color and place of confinement.

The rates of febrility based upon all febrile reactions, including "one-day fever," show a similar arrangement. This relationship persists through and above a hemoglobin range ordinarily considered satisfactory.

Delivery blood loss was measured or estimated in 2,015 cases. For losses of 600 cc. or more, fever rates were from two to ten times the rates for lesser amounts of bleeding. Blood loss within "normal" ranges could not be demonstrably related to the febrility.

Patients with blood losses of less than 600 cc., when subdivided according to prenatal hemoglobin levels and amounts of blood loss, present evidence that puerperal morbidity is related to the blood status at term more closely than to bleeding at delivery, short of serious hemorrhage.

Racial comparisons of hemoglobin distribution, total fever rates, and rates within corresponding hemoglobin ranges, give evidence that the low prenatal blood values prevailing among negroes on this service are an important factor contributing to the much greater incidence of puerperal morbidity in negro women.

The findings indicate that an acid hematin test during the last month of pregnancy is a useful index of potential resistance to infection. They serve to emphasize the importance of hemoglobin determinations at intervals during pregnancy. Commonly encountered values between 10 and 12 gm., whether "normal" or not, seem to express a status distinctly less satisfactory than higher levels. With due respect to the conservation of blood at delivery, the blood content with which a woman reaches term seems deserving of equal attention.

EDWARD L. CORNELL, M.D.

**Young, J.: The Eclamptic Phenomenon and Placental Ischemia.** *J. Obst. Gyn. Brit. Empire*, 1942, 49: 221.

The authors claim that the toxemias of pregnancy are preceded and determined by an "abortion factor," which operates by causing an interference with the maternal circulation in the placenta. This may operate in either of two ways:

1. It may produce a stasis of the blood flow in certain areas which results in local areas of placental degeneration. If there is an interval of survival of the fetus with continued circulation in the remainder of the placenta, the ischemic areas become infarcted.

2. There may be vascular changes widespread throughout the decidua which may involve even the uterine muscularis and cause extensive extravasation of the blood which manifests itself as retroplacental bleeding.

The toxemias are believed to develop following the placental degeneration, the severity being determined by the extent of the placental involvement and the time during which the fetus survives *in utero*. Half of the placenta may be involved before death of the fetus occurs. These observations serve to explain the high incidence and grave nature of the toxemia in concealed accidental hemorrhage.

Such cases in which there is no evidence of toxemia can be explained by sudden profound involvement of the placenta resulting in immediate fetal death. In concealed accidental hemorrhage an acute renal lesion, suppression of urine, and a rising blood urea may be superimposed on the typical pre-eclamptic or eclamptic phenomenon. A correlation has not been found between the placenta and the minor clinical manifestations of toxemia. The latter may arise from a lesion which thus far eludes the present methods of detection. JOSEPH E. FIELDS, M.D.

**Pérez, M. L., Arenas, N., and Blanchard, O.: The Evolution and Treatment of Lymphogranuloma Venereum During and After the Puerperium.** (Evolucion y tratamiento de una linfogranulomatosis venerea durante y fuera del estado puerperal.) *Bol. Soc. obst. gin. B. Aires*, 1942, 21: 167.

In a previous publication the authors established the rarity with which pregnancy occurs in women with lesions of lymphogranuloma venereum. In the present communication they state that in their hospital only 1 case in 43,000 parturients was encountered. They explain the low incidence on the basis that the women who are exposed to venereal diseases are usually sterile anyway. The etiology of this condition remains controversial. Attempts have been made to explain it on the basis of hereditary or extrauterine transmission. Because the cause is not yet solved, the authors urge intensive study of each case which is encountered and emphasize the necessity of reporting such cases. Once the pregnancy occurs, abortion is rarely observed; the pregnancy usually goes to term without special therapy being instituted. Wilson and Close observed only 1 spontaneous abortion in 18 cases of lymphogranulomatosis. The authors also state that the pregnancy did not appear to alter greatly the course of the disease.

The reason the parturition in such patients may be dystocial is because of pelvic, vaginal, or vulvar infiltration which might cause disagreeable complications. For this reason, many authors advocate cesarean section in such cases. However, the authors believe that in the majority of cases the parturition is normal but that the labor should be carefully observed to prevent disagreeable complications.

Before 1938 there were many suggested methods of treatment, the use of antimony, tartar emetic, or faudin being especially advocated. In cases of rectal stenosis dilatation was produced by Hegar dilators, with or without diathermy. There were varied cures for fistulas, even by means of colostomy. However, in 1938, Gjuric reported good results obtained from the combined use of faudin and sulfanilamide, as did many others. Grace obtained good results in 31 cases by the administration of sulfanilamide, and sulfathiazole gave even better results and caused no toxic manifestations. The authors believe that sulfanilamide therapy is of great value in those cases in which there is no rectal stenosis. Even in the presence of rectal stenosis it improves the suppurative lesions and thus facilitates the treatment of the stenosis.

Recently surgical treatment has been considered best for cases of rectal stenosis; some prefer rectal amputation with or without conservation of the sphincter, and others merely provide an artificial anus. The authors, however, prefer electrocoagulation because it permits complete extirpation of the diseased tissue and avoids closure of the lymphatics and propagation of the disease.

They present a case of pregnancy associated with venereal lymphogranulomatosis successfully treated by sulfanilamide therapy and electrocoagulation.

MICHAEL DEBAKEY, M.D.

**Mariette, E. S., Larson, L. M., and Litzenberg, J. C.: The Treatment of the Tuberculous Woman During Pregnancy.** *Am. J. M. Sc.*, 1942, 203: 866.

With the development of the roentgen ray, the sanatorium movement, and the appreciation of the importance of rest, both general and localized, in the treatment of tuberculosis, a better understanding of tuberculosis and the mechanism of recovery has resulted. As a result, the emphasis in the treatment during pregnancy has gradually shifted from those measures which will affect the frame and figure to a direct attempt to control the tuberculous process itself.

This change in the emphasis of treatment caused the authors (in 1921) to question the necessity of abortion in the pregnant tuberculous woman just because of the tuberculosis.

With that premise in mind the authors have divided their patients into two groups, those with active tuberculosis and those with chronic so-called "arrested" tuberculosis. The treatment of the two

groups, of course, is different. The woman with active tuberculosis should have plenty of bed rest and such additional methods of treatment as pneumothorax and other forms of collapse therapy which would be used if pregnancy were not present. This is true particularly following labor when more intensive treatment may be indicated to prevent a spread of the disease when the stimulating effect of pregnancy is removed.

The exact treatment which the women with the "arrested" tuberculosis receive varies with the individual case and condition. In general, however, they are kept in bed, except for bathroom privileges, for the last two or three months prior to delivery, and on strict bed rest for a month or six weeks after delivery. They are then allowed gradually to get up and to start exercise and are discharged in perhaps another six weeks. Of course, they are not permitted to nurse their babies, which are kept away from them after birth.

With this general premise in mind the authors have found it necessary to advise abortion in only 1 sanatorium case since 1921.

Of 86 women from eighteen to thirty-nine years of age, whose pregnancy was allowed to go to full term during the years from 1921 to 1940, 64 were delivered at the sanatorium and 22 were delivered elsewhere. Of the 82 followed up, 15 (18.3 per cent) are dead, while 39.1 per cent of the women in the same age group who were discharged from the sanatorium for the first time during the same period were also dead. If those having premature deliveries are considered, 19 (21.6 per cent) are dead in contrast to the 39.1 per cent of all the women in the same age group who were discharged from the sanatorium for the first time during that interval.

While this group is too small to warrant definite conclusions, still the length of the study gives it some value. It seems to indicate that when the tuberculosis is properly treated, pregnancy probably does not adversely affect the tuberculous process. This should be a great boon to those people who have wanted children but who have felt that they could not have them because of tuberculosis.

There are many variables which will require further study before one can explain why the death rate for all women from eighteen to thirty-nine years of age following their first discharge is approximately twice that of the pregnant group. This incidence, however, is another factor influencing the conclusion that tuberculosis *per se* does not necessarily constitute an indication for therapeutic abortion. Conversely, if any condition should exist which would be considered an indication for therapeutic abortion if tuberculosis did not exist, then an abortion should be done even though tuberculosis does exist.

Treatment of the pregnant woman with tuberculosis by the most modern methods of combating the disease, together with equally modern prenatal care, apparently offers her as good a chance for recovery from her tuberculosis as though pregnancy did not exist.

Of the 70 children born to the 64 mothers, 4 were not traced, which left 66 for further study. Of this group, 1 was stillborn and 3 others have died of nontuberculous conditions. Of the 62 who are living and were traced, 2 became tuberculin-positive while still in the preventorium. One of these apparently acquired the infection from a grandmother. The remaining 60 children are all well and free from infection and disease as far as is known.

DANIEL G. MORTON, M.D.

**Barnes, J.: Inhibition of Lactation by Synthetic Estrogens.** *Brit. M. J.*, 1942, 1: 601.

The synthetic estrogenic substances, stilbestrol, dienestrol, and hexestrol, were given orally to 134 patients in whom it was necessary to inhibit lactation: 81 received stilbestrol, 37 dienestrol, and 16 hexestrol.

Ultimate success with regard to lactation was obtained in all cases, although in some there were breast symptoms. Forty-nine of the patients receiving stilbestrol, 15 of those receiving dienestrol, and 6 of those receiving hexestrol were symptom-free. The symptoms complained of in the remainder amounted to no more than a slight fullness of the breasts or a temporary leakage of milk. These results stand in contrast to the older methods of treatment, with which very hard and painful breasts were often seen.

The results were better when treatment was begun within one day of delivery than when it was started later. They were also better in patients in whom pregnancy had advanced beyond thirty-two weeks than in those in the earlier months of pregnancy. Cases of pregnancy terminating between the twentieth and the twenty-eighth week were especially difficult to treat.

After treatment was stopped on the fifth day the breasts filled up in about a quarter of the cases and further treatment was necessary, but ultimate success was achieved in every case.

Three patients with engorged breasts were successfully treated for this condition while lactation continued normally.

In the dosage tried, stilbestrol was more effective than hexestrol. Dienestrol is a very potent estrogenic substance, and success was achieved with one-tenth of the dose required for stilbestrol.

No ill effects from the treatment were noted, apart from complaints of transient nausea in 3 patients.

Synthetic estrogenic substances are valuable for the inhibition of lactation and for the treatment of engorged breasts. They are cheap and effective, and are easily given by mouth.

DANIEL G. MORTON, M.D.

# GENITOURINARY SURGERY

## ADRENAL, KIDNEY, AND URETER

**Thorn, G. W., Dorrance, S. S., and Day, E.: Addison's Disease. Evaluation of Synthetic Desoxycorticosterone-Acetate Therapy in 158 Patients.** *Ann. Int. M.*, 1942, 16: 1053.

This report is a summary of observations made on 158 patients with typical signs and symptoms of Addison's disease, all of whom were treated with synthetic desoxycorticosterone acetate. The more detailed data reported refers only to the 64 patients who were under the direct supervision of the authors, whereas the general data refers to the entire group including the 94 cases treated by physicians elsewhere.

The etiological factors related to this group are classified as tuberculous and nontuberculous. On the basis of a clinical and laboratory diagnosis only 40 per cent belong in the tuberculous group, whereas 50 per cent of the cases coming to autopsy were classified as tuberculous. These figures are considerably lower than in other reports.

The average age for the entire group of patients was thirty-eight and four-tenths years with approximately 80 per cent between twenty and fifty years of age.

Weakness, fatigability, increasing pigmentation, anorexia, and nausea were the most frequent symptoms. Ten patients expressed an increase in "salt appetite."

Of the group of 64 patients reported upon by Johns Hopkins Hospital 58 had been seen at some time in a typical adrenal crisis. In the other 94 cases the diagnosis was made by the reporting physicians. The diagnosis of Addison's disease was substantiated in each instance in which a post-mortem examination was made.

Prior to the implantation of pellets of synthetic desoxycorticosterone acetate, patients were regulated and maintained for a month or more by daily intramuscular injections of synthetic hormone in oil, with or without supplementary sodium chloride. As most patients were in rather poor condition on admission, the initial dose of synthetic hormone was considerably larger than the final or maintenance dose. The majority of patients required a maintenance dose of less than 5 mgm. of hormone per day. Pellets were implanted in 148 patients, the number of pellets to be implanted being calculated as follows: for each 0.5 mgm. of hormone required by daily injection, a 125 mgm. synthetic pellet was implanted. As a balancing mechanism for a possible excess of hormone, a small constant quantity of supplementary sodium chloride was administered during the period of assay. This could be increased or decreased as the response to therapy indicated.

Pellets weighing 125 mgm. usually provide effective therapy for twelve months. A gradual reduction in blood pressure indicates an inadequate supply of the hormone. As soon as this occurs, the patient should be stabilized by intramuscular injection and new pellets should be implanted. New pellets should not be implanted until it is certain that little if any of the old pellets remain. Sixty-one patients in this series have received two or more implantations.

The pellets are implanted subcutaneously in the intrascapular region. They are placed in separate subcutaneous pockets, care being taken to be sure they are away from the wound edges and that they are not broken as they are introduced.

Sublingual administration of desoxycorticosterone acetate had been found effective but insufficient.

Over a period of one and seven-tenths years of therapy the mortality for the 158 cases was 15.4 per cent, as compared with a mortality of 44.2 per cent at the end of the one and one-half years in a previous series which received the combined extract and sodium-chloride therapy. In as much as the patients treated with the extract did not receive adequate hormone, this difference probably represents the effect of more adequate hormone therapy in contrast to the changes in chloride therapy. In the group of 64 patients studied at Johns Hopkins Hospital there was an average gain of 4 kgm., a rise in blood pressure, and an increase in the percentage of complete rehabilitation of the patients. The therapeutic results in those treated outside closely paralleled those treated at Johns Hopkins Hospital.

The restoration of plasma volume, plasma electrolytic concentration, and blood pressure by desoxycorticosterone acetate does not correct the disturbance of carbohydrate metabolism seen in Addison's disease. The facilitation of absorption from the gastrointestinal tract was the only change observed; however, adrenocortical extract promotes glyconeogenesis.

Intercurrent infections are the most common cause of adrenal crises in these patients. The aims of treatment of these crises should include:

1. Support of the plasma volume and blood pressure with cortical extract and sodium chloride; to be followed by intramuscular injections of synthetic hormone. Epinephrine may be used to help support or maintain a blood pressure above 90 mm. of mercury.

2. Prevention of hypoglycemia by the administration of glucose and adrenal extract.

3. Treatment of the infection.

Complications which may arise during the use of desoxycorticosterone acetate include: hypertension, edema, cardiac decompensation, tendon contractures, transient paralysis, and hypoglycemia. Upon long and continued administration of sodium chloride in conjunction with the synthetic hormone, disturbance of the ratio between sodium and potassium with a lowering of the latter is observed. This leads

to periodic paralysis which disappears upon restoration of the normal ratio.

Many patients with Addison's disease show electrocardiographic changes suggesting a diseased myocardium. Enlargement of the usually somewhat smaller heart, normally seen in Addison's disease, has been observed in some of the cases treated with the synthetic hormone. No changes in the electrocardiogram appeared to be specific for Addison's disease. Electrocardiographic tracings taken during therapy showed a marked improvement with disappearance of the abnormalities in some patients, whereas others showed an increase in the number of electrocardiographic abnormalities.

The effect of desoxycorticosterone-acetate therapy on the encephalographic records was found to be unpredictable in the patients studied.

The blood changes in patients receiving synthetic hormone were as follows:

A marked increase in plasma volume; decrease of sodium-chloride excretion with an increase in the excretion of potassium and inorganic phosphorus; increase in the carbon-dioxide-combining capacity, decrease in nonprotein nitrogen, and a decrease in the hematocrit and serum protein.

Observations on the basal metabolic rate of patients with Addison's disease showed that there is a tendency of the rate to increase, but this change was inconstant. Similar inconstant results were observed in connection with possible changes in the abnormal pigmentation of the skin. Creatinuria, which has been observed in untreated cases of Addison's disease, disappears following the administration of cortical extract. Observations of the effect of synthetic hormone on the creatin metabolism in Addison's disease suggest that this abnormality is not corrected by this form of therapy.

The early weeks of pregnancy as well as acute infections may precipitate an adrenal crisis. In the presence of these conditions additional synthetic hormone as well as infusions of saline and glucose solutions are indicated.

It has been found that with the present improved therapy of Addison's disease, it is now possible to carry these patients through major surgical procedures. Local anesthesia is the choice for patients with Addison's disease. Operative procedures should be supported with additional doses of adrenocortical extract and desoxycorticosterone acetate for forty-eight hours preceding the operation. Indicated saline and glucose infusions should supplement the hormone therapy. Blood-pressure readings should be made very frequently during the surgical procedure and additional extract administered if the blood pressure falls below 120 mm. of mercury.

ALFRED B. LONGACRE, M.D.

**Keitzer, W. A., and Campbell, J. A.: Renal Complications of Sulfadiazine.** *J. Am. M. Ass.*, 1942, 119: 701.

The authors reported instances of renal complications following the use of sulfadiazine, in spite of repeated assertions that this new drug is particularly free of such hazards. It has been the experience of the authors that as many complications have been observed clinically with sulfadiazine medication as were observed with other of the sulfonamide drugs. The significance of these observations, they point out, are based on the indiscriminate use of the drug in military medicine where facilities to treat renal complications may not be available. The authors found that renal complications occurred by the seventh day with the average daily dose exceeding 4 mgm. and an average blood level of 11 mgm. per 100 cc. They suggest that the lack of gastric distress with this compound permits high dosages and thus complications occur.

A total of 11 cases with renal complications following sulfadiazine are reported. Four of the patients developed renal colic and oliguria of such magnitude that cystoscopy was necessary, while the remaining 7 were treated conservatively with relief. The patients varied in age from two months to seventy-three years. A common finding in these cases was the presence of sulfadiazine crystals and often hematuria. In those individuals who were cystoscoped, crystals were seen packed in the ureteral openings, and in 2 cases true sulfadiazine crystal calculi were observed.

The authors conclude from this analysis that sulfadiazine is as toxic as other sulfonamides, and, therefore, that repeated observation of urinary sediment is essential along with an adequate fluid intake, and a daily dose of 4 grams should not be exceeded.

The following conditions are mentioned as predisposing to renal complications:

1. Anuria due to a sudden concentration of the drug, such as may result in the intravenous exhibition.

2. Dehydration in association with a 4 gm. intake of the drug.

3. Morphological variation of the urinary tract to induce stagnation of urine and thus precipitation of the drug. In this respect two cases are mentioned: (1) a fifty-nine-year-old male with prostatism, and (2) a four-month-old child with hydronephrosis and hydroureter.

In reference to the treatment of renal complications due to sulfadiazine the authors suggest the following:

1. Stop the drug at the first subjective or objective urinary-tract disturbance.

2. Force fluids, but not in quantities to exceed 5,000 cc. of positive water balance as cerebral edema may result.

3. With a 500 cc. output, cystoscopy may be delayed from twelve to twenty-four hours.

4. Cystoscopy with ureteral catheterization is essential when oliguria persists or anuria develops. The ureteral catheters are to be left in place for from twenty-four to forty-eight hours to permit pelvic lavage and should be removed when a clear urine is recovered. Recurrence of renal disturbance

should be treated with reinsertion of the ureteral catheters. The fluid for renal lavage suggested is either 2.5 per cent sodium bicarbonate or physiological saline solution, and the authors on occasion alkalinized the patient with additional parenteral and oral sodium bicarbonate.

5. Retrograde pyelograms should be made prior to the removal of the catheters.

It is pointed out that this plan of treatment is rationalized by the experience of others. Kawaichi and Rogers, and Lindner and Atcheson, both, reported fatal cases, and in each instance conservative treatment was relied upon.

ROBERT LICH, JR., M.D.

## BLADDER, URETHRA, AND PENIS

**Chydenius, J. J.: Irradiation Injuries of the Intestine and Urinary Bladder Following Radium Treatment of Carcinoma of the Uterine Cervix** (Strahlenschaeden des Darmes und der Harnblase bei der Radiumbehandlung des Carcinoma Colli Uteri). *Acta radiol.*, Stockh., 1942, 23: 1.

The difficulties of radium treatment in uterine cancer arise primarily from the unfavorable location of the organ in the center of the broad female pelvis where important surrounding structures are exposed to the injurious effects of irradiation. During the ten years that the author has employed the "Stockholm method" of treatment in uterine cancer, he has paid particular attention to reactions in the rectum and urinary bladder. Aside from primary, quickly subsiding reactions, definite late reactions in the rectum were observed in 33 of 321 cases of carcinoma colli uteri treated by radium and x-ray. Most of these were mild mucosal changes or slight strictures which apparently quickly disappeared. Only in 15 cases could the injury be considered severe. There were 4 cases of vesicovaginal fistula, 5 of rectovaginal fistula, and 6 of late rectal reactions in which either radium ulcer or some degree of stenosis developed.

Only 2 of the vaginal fistulas occurred through previously uninvolved, healthy tissue. A study of the case records indicates that the dosage in milligram hours is not as important a factor in the development of this complication as the variability of the distance of the application from the bladder wall.

The circumstances of occurrence of rectovaginal fistulas are not so clear, except that most of these cases presented Grade III or IV lesions, which show more of a tendency to develop fistula than the less malignant lesions. Furthermore, the limit of tolerance of the tissues is more likely to be exceeded in the hope of eradicating a more malignant lesion. This does not apply to the cases of late rectal reaction without fistulas, all of which belong to Grade II. In these cases the dosage was slightly greater than the usual dosage of the "Stockholm method." Severe symptoms appeared from five to ten months after treatment in the form of tenesmus, bleeding, or complaints indicating stenosis. On rectal examination typical rectal ulceration and induration of the pelvic connective tissues were found, frequently with narrowing of the rectal lumen. All of these cases recovered without active treatment and in only 1 instance was it necessary to create an artificial anus, which later could be closed.

The most severe complications occurred in hopeless cases, in which the carcinoma rather than the treatment determined the origin of the complicating lesion. The whole question is obviously linked up with the degree of malignancy and the end-results obtained. Since the tolerance of the surrounding healthy tissues determines the limits of suitable dosage, the question of intestinal radiation-injury appears to be a major problem of gynecological tumor therapy. Intestinal lesions occur at the site which lies nearest to the radium preparation, and localization of the lesion in the rectum is the commonest and most easily recognized complication. The mechanism of injury appears to be a lowering of the vitality of the mucosa and surrounding tissues through circulatory disturbance and ischemia in association with trauma caused by the fecal mass. The sclerotic and avascular connective tissue shows evidence of injury to arteries, veins, and lymphatics after radium therapy. Irradiation injury is frequently confused with rectal carcinoma or metastases, which sometimes leads to ill-considered surgery or further radiation therapy.

Because of the variability of the distance between the tumor and the rectum in this short distance radiation, the dosage to which the rectum is subject is likewise variable. The law that intensity of radia-

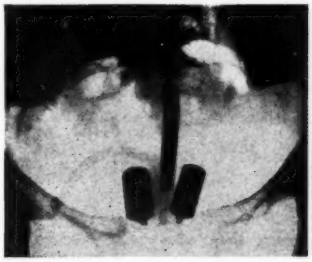


Fig. 1.

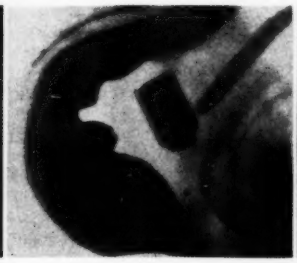


Fig. 2.

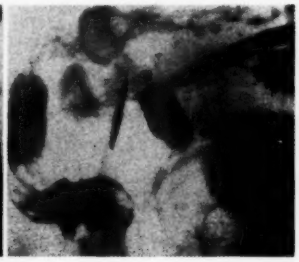


Fig. 3.

tion varies with the square of the distance is of importance in this connection. Rectal injury occurs with widely varying primary doses reckoned in milligram hours so that measurement of dosage in this unit is far from satisfactory. The smallest dose causing injury observed by the author was 2,400 milligram hours in the vagina and 1,800 in the uterus.

In order better to appreciate the importance of distance variation, the author obtained roentgenograms in typical cases with contrast medium in the rectum. Figure 1 shows the radium application in a typical case. The lateral view of the same application (Fig. 2) shows the radium lying very close to the barium-filled rectum at several points. Figure 3 shows another case with more favorable relationships in which the rectum, almost empty and freely movable, lies far removed from the vaginal wall which is demonstrated by the lead marker. The cul-de-sac of Douglas is broad and deep in this case. In front the radium lies dangerously close to the urinary bladder. These figures illustrate the need for an accurate and easy method of dosage calculation for focal doses in radium and roentgen therapy. Attention is called to the author's histological observations and isodose curves calculated in roentgen units in a previous publication. JOHN L. LINDQUIST, M.D.

**McCrea, L. E.: Congenital Absence of the Penis.** *J. Urol.*, Balt., 1942, 47: 818.

A case of congenital absence of the penis, the eleventh recorded in the literature according to the author, is presented together with a brief consideration of the embryological factors involved. It has been estimated that such an anomaly occurs once in 30,000,000 births and is not to be confused with pseudohermaphroditism, hidden penis, or epispadias.

Fig. 1. Complete absence of penis. Pubic hair shows typical masculine distribution; the scrotum is slightly bifid; right testicle hangs slightly lower than left.

Because developmental defects involving the penis and penile urethra are linked with the distal portion of the genital tubercle and urogenital sinus, such malformations are not necessarily associated with upper urinary tract pathology, which takes origin from the wolffian and mullerian ducts. The present instance showed no defect of the urinary tract as could be revealed by intravenous urography, and there was only a slightly bifid appearance of the scrotum as the sole remaining genital defect.

The case presented is that of a nineteen-year-old white male, with essentially negative family history and no antecedent medical complaints. He presented himself for possible surgery, since he was anxious to get married. Local examination revealed a total absence of the penis, a slightly bifid contour to the scrotum, no hernias, and grossly normal testes and prostate. Pubic hair distribution was normal and urinary control was complete.

Examination of the perineum was negative except for a small elevation about 1 cm. in front of the anterior anal margin. This elevation was soft and pliable and it was through this eminence that urination was accomplished. During sexual excitement, the presence of erectile tissue in this eminence was manifested by some enlargement and increased sensitivity, and on manipulation, an apparent seminal ejaculation occurred. ARTHUR H. MILBERT, M.D.

## GENITAL ORGANS

**Spotoft, J.: Varicocele.** *Acta chir. scand.*, 1942, 86: 1

The purpose of the present work is to account for what we now know of the so-called idiopathic varicocele, and the numerous theories concerning the etiology are mentioned. The cause is not definitely understood but it is probable that a complexity of factors is required to cause a varicocele, the further development of which probably depends on a vicious circle between the dilatation of the vein and an overstretching of the cremaster.

After mentioning the symptoms, diagnosis, and course of varicocele, the author describes and discusses the different forms of treatment. The treatment is divided into three types, i.e., conservative treatment, injection treatment, and surgical treatment.

The many surgical methods may again be divided into three types: operations on the scrotum and the funicular layers, operations on the pampiniform plexus, and suspension operations. The different operations are reviewed, several of them illustrated, and their technique is described.

The available reports and the value of the different methods are discussed.

The writer's own material comprises 27 patients operated on during the years from 1924 to 1938 by plexus resection and suspension of the testicle in a flap from the fascia lata. Twenty-two of the patients

were re-examined, and the results are discussed. These results substantiate the sad experience which other authors have had with plexus resection, the functional results of which may in many cases be paralleled with semicastration.

Finally, the indications for operation are discussed. On the whole, great reservation with regard to operation is necessary, particularly if the patient presents signs of sexual neurasthenia. In all cases conservative treatment must be tried first. In case of operation, scrotum and plexus resection must be avoided, and one of the suspension methods must be chosen, the principle of which is the interruption of the vicious circle between the dilatation of the vein and the overstretching of the cremaster.

JOHN A. LOEF, M.D.

## MISCELLANEOUS

**Barnes, R. W., and Hill, M. R.: Intestinovesical Fistula.** *California West. M.*, 1942, 56: 347.

The frequency of communications between the urinary bladder and the intestinal tract is worthy of note inasmuch as the presenting symptoms are those of a severe intractable cystitis. Very frequently several examinations are required to make the diagnosis. Usually the fistula is caused by pathology which originates in the intestinal tract. Fourteen cases of this condition are reported in detail, the symptoms of which were those of cystitis: frequency, burning on urination, and urgency, with usually a small bladder capacity.

The most characteristic symptom of this condition, however, is pneumaturia. This is almost diagnostic; it was present in all but 1 of the cases. The patient does not usually mention this symptom when he is giving his history, for it is not painful nor even inconvenient. For this reason, whenever a history on a case of unexplained cystitis is taken, the patient should always be asked whether or not he has passed gas from the bladder. Symptoms in those cases which have a large patent fistula are the passage of feces from the bladder, and of liquid stools from the bowel. When the fistula is caused by diverticulitis, the patient has a low-grade fever and frequently gives a history of having had pain in the lower abdomen, which subsided when he began to notice the passage of gas from the bladder.

The most dependable means of making a diagnosis is with the cystoscope. If it cannot be made by observation, a cystogram may demonstrate the flow of cystographic fluid from the distended bladder into the bowel. Gas and feces passed by the urethra would be very suggestive. At times a proctoscopic examination will aid, or a barium enema will show the fistulous tract. Treatment very often is difficult. Large abscesses must be drained. In many cases it is necessary to do a preliminary colostomy before any attempt is made to correct the intestinovesical fistula.

Of the 14 cases reported, 7 were operated upon. Six were successfully cured. After operation and closure of the abdomen, a retention catheter is inserted into the bladder through the urethra and is kept under careful observation to see that it drains well at all times. The bladder is not irrigated unless the catheter fails to drain. The sutures in the bladder will hold better if the bladder is kept at rest. The third stage of the operation is the closure of the colostomy, which is done from eight to twelve weeks following the repair of the fistula.

ELMER HESS, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

**Hoobler, S. W.: The Syndrome of Cervical Rib with Subclavian Arterial Thrombosis and Hemiplegia Due to Cerebral Embolism.** *N. England J. M.*, 1942, 226: 942.

The rare syndrome of thrombosis of the subclavian artery as a source of cerebral embolism is reviewed together with the presentation of an additional case. In 2 of the reported cases there were cervical ribs and in 1 an old ununited fracture of the right clavicle with downward and backward displacement on the right subclavian artery. In another case, autopsy revealed a congenital sacculated aneurysm of the right axillary artery. The pathological findings are extremely interesting since in all of the cases thrombosis occurred in the right subclavian artery and the cerebral lesion was also on the right side. Apparently the retrograde thrombus in the subclavian artery communicates with the common carotid artery through the innominate artery only on the right side. Should thrombosis occur in the left subclavian artery, emboli would be carried into the aorta and lodge in places where they would be less apt to produce cerebral symptoms.

The author presents his case of a young man who had previously had resection of the right scalenus anticus muscle to relieve symptoms of cervical-rib syndrome (bilaterally). He had no recurrence of symptoms until several months prior to admission when paresthesia and weakness of the right arm recurred. On admission he presented the picture of a right hemiparesis and in addition the right radial and brachial pulses could not be detected. Several days after entry, pain and numbness occurred over the right shoulder and hand and the subclavian artery ceased to pulsate. A hard, tender fusiform mass had replaced the previously dilated pulsating subclavian artery. Gradually the pain and numbness decreased, the hemiparesis regressed, and the patient left the hospital sixteen days after admission.

Apparently the cervical rib had set up sympathetic nerve irritation to produce brachial spasm and retrograde thrombosis of the subclavian artery. However, adequate collateral circulation developed.

DANIEL H. LEVINTHAL, M.D.

**Hellstadius, A.: On the Ability of Bone Tissue (Including "Os Novum") to Survive in Pedicled Bone Grafts.** *Acta chir. scand.*, 1942, 86: 85.

The result of bone grafting in pseudarthrosis and extra-articular arthrodesis has often been unsatisfactory and many workers have used pedicled bone grafts in preference to free bone grafts in which the blood supply was completely cut off. By using a pedicled graft they expected better results because of retaining some nutrition to the graft.

In congenital pseudarthrosis of the tibia bone grafts with soft part pedicles have been used from the same leg (Mueller–Koenig) and from the opposite tibia (Reichel). The soft pedicle consisted of skin and subcutis. In Haas's extra-articular arthrodesis of the hip joint the chiselled off trochanter with the attached musculature was used. In pseudarthrosis of the humerus the axillary part of the scapula with the attached teres major and minor was used (Codivilla). In pseudarthrosis or major defects of the tibia, the fibula with its muscular flap was transplanted (Hahn and Huntington).

Although the clinical results did not seem to bear out that pedicled bone grafting was superior to free bone grafts, Barth found in the course of animal experiments that the majority of bone cells in pedicled bone didn't undergo autolysis. By shutting off different vascular areas (periosteum, metaphyseal blood supply, and nutritional artery) in different experiments, Johnson found that the periosteum was able to nourish only the outer half of the cortex, while either the metaphyseal vascular area or the nutritional artery could supply the bone marrow and the inner half of the cortex with the necessary amount of blood. Histological examinations of free bone grafts (Barth, Razimowsky, Marchand, Axhausen, Lexer) conclusively proved that absorption and regeneration of bone cells occurred around granulation tissue advancing from the periosteum and endosteum into the dead bone graft. A similar process was found around the haversian canals. Opinions differ as to the fate of the soft tissue in the bone graft, i.e., periosteum, endosteum, and connective tissue in the haversian canals.

The result of explantation (tissue cultivation) of periosteum showed a growth of newly formed cells into the substratum. When tissues under such unfavorable circumstances are able to survive, it can reasonably be assumed that the soft tissue in bone grafts is kept alive until new blood vessels have developed. The presence and the number of bone cells in the lacunae is determined by the age of the animal and by the time which elapses from the actual bone grafting to the time of histological examination. In young animals areas of intact bone cells remained unchanged for a considerable length of time. Axhausen found that a small number of normal bone cells were uniformly distributed in a human bone graft fifty-one days old. This, however, does not prove that these cells have survived the grafting operation. The preserved staining capacity can be explained by a retarded autolysis. On the other hand, a few empty lacunae occur in perfectly normal bone.

Two types of animal experiments of pedicled bone grafts are presented. In one the periosteal blood supply was retained by a flap of skin or muscle, in the other the blood supply of the periosteum as

well as that of the nutritional artery was preserved. It was found that in both types of pedicled bone grafts the bone cells went through similar changes as they did in free bone grafts. It was further shown how very sensitive bone cells were to even partial interruption of their blood supply. This also was verified by investigations carried out by Mueller, Jaffe, and Pomerans.

Bone tissues of patients with arteriosclerotic or diabetic gangrene showed necrosis of the bone cells at a much higher level than the gangrene of the soft tissues would indicate. This again illustrated how much more sensitive bone tissue is to disturbances in the blood supply than connective tissue, muscles, or skin.

As to new bone formation, there was but little difference between the results from free and pedicled bone grafts. A similar progress and similar changes were found in both forms. A specific bone-building substance is liberated from dead bone and carried with the tissue fluid to the mesenchymal tissues of the inner and outer layers of the bone, stimulating formation of new bone (Levander and Annersten). The process of bone formation begins in the superficial haversian canals and extends to the deeper layers of the bone graft.

It also was noted that in cases of entire diaphyseal bone transplants the absorption and regeneration of bone took place very slowly and only at the periosteal surface of the bone. In splintered bone transplants there was found to be endosteal formation of new bone in addition to the periosteal bone formation. In these cases the formed granulation tissue had more chance to invade the bone marrow from without and could initiate lively formation of new bone.

Experiments were carried out with a pedicled "os novum" transplant. Orell introduced the "os novum" as grafting material. A specially prepared piece of bone (os purum) was placed under the tibial periosteum. After from four to eight weeks new bone (os novum) developed under the periosteum; it was made up of osteoid and connective tissue. Considerable hyperemia arose in the periosteum and the surrounding tissues and gave the new bone (os novum) an abundant periosteal vascular supply. In the course of new bone formation osteoid tissue was laid down in the form of trabeculae in the granulation tissue of the periosteum and the surrounding tissues. When "os novum" was used as a free bone graft the greater part of its tissue disappeared but some of it gradually assumed the character of mature bone tissue. There was continuous destruction and rebuilding of osteoblasts within the osteoid tissues. In young osteoid tissues the osteoblasts survived. In older osteoid tissue in which the osteoblasts approached the stage of mature bone cells the sensitivity to nutritional disturbances was more marked. The more immature the cells were, the better they survived the transplantation. A bone graft of "os novum" would be of benefit in cases of pseudarthrosis in which scar and fibrous tissue is abundant and the blood supply poor. Free transplantations with five weeks old "os novum" have been carried out with good results (Orell).

The assumption seemed justified that in pedicled "os novum" grafting when the blood supply was preserved the new bone should have a better chance to survive than an ordinary free "os novum." However, changes within the bone graft and the histological pictures were similar to those found in nonpedicled free os-novum transplants.

Microphotographs of histological sections of pedicled and free bone grafts are shown and the operative technique used by the author in each of his animal experiments is described in detail.

GEORGE I. REISS, M.D.

## FRACTURES AND DISLOCATIONS

**Moberg, E.: Wound Healing in Compound Fractures of the Long Hollow Bones** (Zur Frage der Wundheilung bei komplizierten Frakturen der langen Roehrenknochen). *Acta chir. scand.*, 1942, 86: 43.

The author believes that the improvement in wound healing of compound fractures and the comparatively fewer complications encountered in recent years are in great measure due to the utilization of the principles of treatment advocated by Friedrich.

The present report is based on a study of 183 compound fractures of the long hollow bones treated at the Lund Clinic from 1926 to 1935. These following factors were important in determining the outcome of these cases:

1. The time period between the occurrence of the injury and the institution of treatment (this was unimportant if not more than four hours.)

2. The character and extent of the complicating wound. Tabular and graphic reviews of the cases studied are presented by the author.

3. The nature and extent of wound soiling. Geographic and industrial circumstances often determined the amount of wound soiling. These factors were especially significant with respect to the development of gas gangrene. Injuries sustained in the farming industry were particularly apt to develop secondary infection and gas gangrene. Wounds soiled by hay or straw rarely tended to heal by first intention. Primary conversion of compound fractures to simple fractures should be undertaken with great circumspection in farm workers.

HARRY A. SALZMANN, M.D.

**Sever, J. W.: Colles' Fracture. A Study of X-Ray Films Before and After Reduction.** *N. England J. M.*, 1942, 226: 790.

Measurements were made of the degree of deformity of the distal radial fragment in relation to the long axis of the shaft before and after reduction of Colles' fracture when films were available.

One hundred ninety-nine cases were studied (40 men and 159 women). The right wrist was fractured

in 89 cases, and the left in 112 cases, with the ulnar styloid involved in 84 cases. Before reduction 181 cases averaged −28 degrees from the perpendicular. Ten cases averaged 7.8 degrees which is about half normal. Sixty cases or 39 per cent were not entirely satisfactorily reduced (from 90 to −8.3 degrees). In 92 other cases the average angle was +10.9 degrees. (Normal is +15 degrees.)

The procedure given for reduction is loosening of the impaction, flexion of the backwardly rotated distal fragment, and adduction of the hand. A measurement of the distal radial displacement before and after reduction is advocated for all roentgen-ray reports. RICHARD J. BENNETT, JR., M.D.

**Sjögren, S. E.: Solitary Fractures of the First Rib** (Isolierte Frakturen der ersten Rippe). *Acta radiol.*, Stockh., 1942, 23: 79.

The author reports 5 cases of fracture of the first rib and calls attention to the increasing number of reports of this injury. Because of its protected position the first rib is not often the site of fracture. These fractures are of interest, not only because of their relative rarity, but also because of the fact that they give rise to a clinical picture different from that of other rib fractures. They are not as rare as formerly was thought, but when present they are frequently not found on roentgen examination. The symptomatology of fracture of the first rib suggests a lung or pleural injury, and therefore roentgen examination is usually directed to the lung fields and fails to show the fractured rib. Special roentgen ray techniques are often necessary to visualize the locality of the fracture. Axen, in a roentgen study of 17,000 recruits, found 4 healed fractures of the first rib. This would make the incidence 1 in from 4,000 to 5,000 among symptom-free males undergoing lung examination. In a clinic for trauma the incidence would undoubtedly be a great deal higher.

Fig. 1. Fracture of the first rib near the vertebra column. Note the roentgen projection.

The mechanism of fracture of the first rib is of considerable theoretical interest. Lane believes that this fracture occurs in only 3 ways: by indirect violence transmitted through the clavicle; by direct violence from behind; or by indirect violence *via* the manubrium. The most common mechanism appears to be the first, with the clavicle acting as a lever. If the shoulder is forced upward and backward by trauma, the clavicle impinges with force on the first rib, especially when the latter is fixed by contraction of the scalenus muscles. In accordance with the laws of the lever, the force transmitted to the rib is about three times greater than that to the shoulder. If the force is extremely severe there may be an associated fracture of the clavicle or a luxation of the sternoclavicular joint anteriorly. This mechanism explains the occurrence of fracture of the first rib as a result of force applied at the shoulder or manubrium, but does not explain all cases of fracture.

Some cases occur although no apparent violence has struck the upper part of the body. Ostrowski reports a case in which a man, whose both legs were run over, sustained a rib fracture and died of hemorrhage from a wound of the subclavian artery. The explanation of this and similar cases is that extremely powerful and unco-ordinated muscle contractions which are made in an effort to escape injury cause the fracture. In falls from a height the sudden expulsion of air from the lungs and the subsequent sharp fall in thoracic pressure may be a contributing mechanism.

Another group of cases occurs without any external trauma and in these instances the cause must be attributed to muscle action. It is known that the other ribs can be fractured by coughing. Such a mechanism explains the occurrence of fracture of the first rib with forceful movements of the head in association with the lifting or pulling of a heavy object. When sudden severe pain in the region of one shoulder follows the effort and roentgen examination reveals a fresh rib fracture, one must conclude that the mechanism was muscle pull. In other cases, not so common, it appears that constant muscle pull can produce changes in the structure of the bone so that a break in continuity may occur in the manner of a so-called march fracture. About two-thirds of the cases of fracture of the first rib are a result of external violence.

The symptoms of fracture of the first rib are sticking pain in the region of the shoulder with aggravation of the pain when head and arm movements are made. In most cases the pain is not aggravated by respiratory movements, since the mobility of the first rib with respiration is insignificant. Objective findings are often lacking, and if a suspected fracture in the region of the shoulder cannot be found, it is usually concluded that the

symptoms are due to lung changes. Positive diagnosis can be made only on roentgen examination, which is often not easy, especially in fresh linear fractures without displacement. Special views are often necessary. Only a fracture of the anterior portion of the first rib can be demonstrated in a frontal view. When the fracture is elsewhere, tangential views are best. These are obtained by rotating the patient against the screen in such a manner that the involved shoulder lies next to the screen. This is approximately the position for a frontal view of the shoulder joint.

Normal union of these fractures is the rule but resulting pseudarthroses have been reported. Reactive bone changes appear at the fracture site if later roentgen studies are made, and the visualization of these changes differentiates a true fracture from a pre-existing pseudarthrosis.

Because of the intimate relationship between the first rib and the brachial plexus and subclavian artery and vein, serious or fatal complications of the fracture may occur and have been reported. In addition to such special complications, the more common complications of rib fractures, namely, pneumothorax or other lung and pleural lesions, may occur. Secondary nerve lesions sometimes result from involvement of the nerves by callus. The development of a Horner's syndrome following fracture of the first rib has been reported.

JOHN L. LINDQUIST, M.D.

## ORTHOPEDICS IN GENERAL

**Clausen, A.: Cystic Tuberculosis in the Long Hollow Bones** (Zystische Tuberkulose in den langen Roehrenknochen). *Acta radiol*, Stockh., 1942, 23: 99.

In 1920 Juengling first presented 4 cases of bone pathology which later became known as "osteitis tuberculosa multiplex cystica of Juengling," the term "cystica" later being changed to "cystoid." Juengling noted 2 types:

Type 1. The disease process was limited chiefly to the phalanges and metacarpus, or to the metatarsal region, and was characterized by moderate swelling of the bone. The latter was filled by a network of cystoid areas of rarefaction and surrounded by thinned-out cortical layers which were broken through in places and presented little possibility of preventing the process from involving the remaining portion of the bone.

Type 2. This was regarded by Juengling as an end-stage of the disease and was characterized by the presence of sharply defined, discrete, translucent areas in otherwise normal, though slightly sclerotic, bone.

Fig. 1.

Fig. 2.

Juengling later described a subdivision of Type 2, which he regarded as Type 3. This was characterized by the presence of small, spotty, translucent areas. The normal bone configuration in these cases was characterized by a fine network, a scarcely definable cortex, and hazy transition to normal bone.

The tuberculous origin of this condition, although disputed by various observers, is fairly well established. At first the condition was thought to be limited exclusively to the skeletal structures of the hand and foot. However, various writers, including Juengling himself, have reported similar cystoid changes in the bones of the nose, and in the ulna, radius, humerus, tibia, and fibula. These cases were verified by bacteriological studies and guinea-pig inoculation. At first it was believed that cystoid tuberculosis did not occur before the age of ten years, but various reports in the literature (Law and Perham, Schwenter, and others) have shown that this disease may occur even during the earliest months of infancy.

Two cases of cystoid tuberculosis of the long bones are reported. In each case only an isolated bone (radius and knee joint) was involved. Treatment, which gave satisfactory results, consisted of supportive measures and of putting the part at rest by means of plaster splints.

The author stresses the importance of bearing in mind cystoid tuberculosis of the bones and joints in the diagnosis of cases exhibiting cystic changes in the bones without any noteworthy reaction in the periosteum or in the surrounding bone tissue.

HARRY A. SALZMANN, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

**Hamby, W. B.: Intracranial Aneurysms of the Internal Carotid Artery and Its Branches.** *J. Internat. Coll. Surgeons*, 1942, 5: 216.

The various types of aneurysms of the internal carotid artery and its branches are described, and proved examples of several types are recorded. One of the cases reported is an example of the rare bilateral internal carotid artery aneurysm.

The signs and symptoms of these lesions vary with their location. If the onset is accompanied by subarachnoid hemorrhage, the nature of the lesion is apparent immediately. If the lesion does not leak, the abrupt onset of symptoms should direct attention to the possibility of aneurysm. In some patients the progress is slow and indistinguishable from that of neoplasm. Trigeminal phenomena are usually more or less continuous, with acute exacerbations of pain which is less severe than that of trigeminal neuralgia. It is helpful to compress the carotid artery digitally in these cases, since the trigeminal pain due to aneurysm may be relieved while the aneurysm is obliterated.

The roentgen diagnosis of intracranial aneurysm depends upon the demonstration of opacities in the aneurysmal wall and erosions of contiguous bone, or upon the visualization of the lesion by arteriography. While the sellar erosion due to aneurysm may simulate that of pituitary adenoma, it is usually confined to one side of the sella with a tendency toward elevation or destruction of the anterior clinoid process. Angiography furnishes the best clue as to precise location and operability of aneurysms of Willis's circle.

A subclinical aneurysm within the cavernous sinus usually responds to ligation of the internal carotid artery in the neck. Since sudden occlusion of the artery may result in massive hemispheric ischemia, it is advisable to apply graduated digital compression to the artery in the neck as a preliminary step. When occlusion can be tolerated for from fifteen to thirty minutes without symptoms, it is probably safe to ligate the artery. In some patients who tolerate compression poorly and whose condition precludes long delay, it is safer first to ligate the common carotid artery. This permits reverse flow of blood from the external into the internal carotid artery. After further digital compression proves it safe, the internal carotid can be ligated. Leaking intracranial aneurysms that can be localized clinically or by arteriography should be cured surgically if possible, since fatal recurrence threatens. JOHN L. LINDQUIST, M.D

**Rychener, R. O.: The Use of Heparin in the Treatment of Thrombosis of the Central Vein of the Retina.** *South. M. J.*, 1942, 35: 652.

A study of 9 patients with complete or partial occlusion of the central vein of the retina subjected to the treatment with heparin leads Rychener to the following conclusions:

It is useless to administer heparin to patients with total occlusion of long standing. Heparin should be administered adequately (which means extending the coagulation time to at least fifteen minutes and maintaining it at this level for from seven to ten days) to all patients with total occlusions which have been present for three weeks or less. It is worth consideration in all patients with tributary occlusions and definitely should be administered if the thrombosis appears to be extending to other branches of the central vein. J. M. MORA, M.D.

**Pratt, G. H.: The Surgical Treatment of Peripheral Embolism.** *Am. J. Surg.*, 1942, 56: 566.

Surgical treatment of peripheral embolism has been confined to major amputation, if the patient survived until demarcation was complete. In 80 per cent of embolisms there is disease on the left side of the heart, usually a rheumatic endocarditis. There may or may not be arterial disease. In most instances there is some added insult to the heart such as auricular fibrillation, a surgical operation, or a severe infection.

The diagnosis is usually not difficult. The history of a patient with a diseased heart and fibrillation, or who has had some added insult to the circulatory system with sharp, shocking pain, tenderness at or below the site of embolism, loss of function and color, and a change in temperature is at once suggestive.

The usual location of an embolus is at the bifurcation of the artery, such as at the division of the abdominal aorta, the junction of the external iliac and hypogastric branches, the femoral and the femoral profunda area, and the anterior and posterior tibial arteries. Spasm is the marked factor in all embolisms and is the cause of the pain. The collateral arteries are closed and a true ischemia occurs. In certain instances this spasm relaxes and the collaterals relieve the condition. This fact has been the basis of certain conservative measures of therapy.

The problem of surgical treatment is comparatively recent, and according to Pratt surgery should be resorted to as soon as the diagnosis is made. The technique used by him consists in local anesthesia, the isolation of the femoral artery, and a longitudinal incision over the thrombus in the artery. The thrombus is removed from the distal end first and a soft rubber catheter is passed to prevent the passage of clots below the incision. The thrombus in the proximal end is then removed, and as it breaks away from the embolus proper, it leaves the embolus attached in the lumen. A wire corkscrew instrument is then inserted up the artery, the intima being protected by a rubber catheter. When the obstruction is reached, the catheter is withdrawn and usually when the

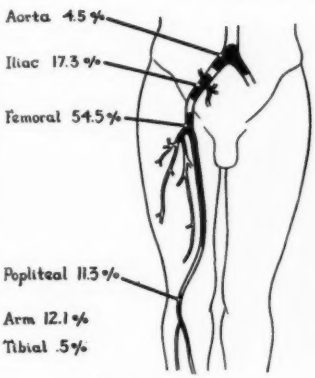
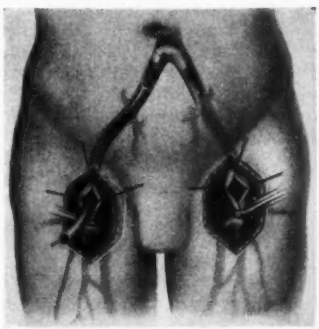



Fig. 1.



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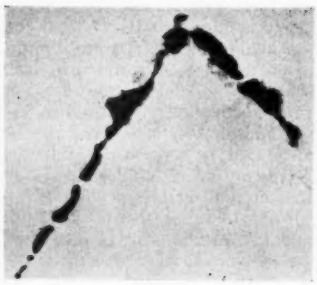

Fig. 3.

corkscrew is pulled down the embolus begins to pass. One must adapt changes in technique to the pathological conditions present. If there is not a free flow of spurting blood after the removal of the embolus, there is still some obstruction and further efforts are necessary to free the artery. If there are bilateral symptoms, both femoral arteries should be exposed at once. The arterial wound is then closed with fine silk on minute curved needles, the sutures being placed so as not to enter the intima. Frequently, a single running suture is sufficient to prevent bleeding. Irrigation of the artery at operation with 25 per cent heparin solution is a recent and helpful addition to the technique, and probably prevents some immediate thrombosis.

To illustrate what can be accomplished in an apparently hopeless state, Pratt briefly records the history, operation, and after-care of a patient in whom a large saddle embolus was removed sixty hours after its lodgment with survival and complete restoration of the circulation in one limb, and in the other down to the knee.

STEPHEN A. ZIEMAN, M.D.

## BLOOD; TRANSFUSION

**Bauer, G.: Heparin as a Therapeutic Agent against Thrombosis.** *Acta chir. scand.*, 1942, 86: 267.

Bauer discusses the value of heparin as a therapeutic agent in the treatment of thromboembolic disease, more from the standpoint of active treatment than as a prophylactic. Venography is essential for early diagnosis (especially when the lower extremities are involved), and large doses of heparin are used. The author suggests that patients be allowed out of bed as soon as heparinization is completed. There were no untoward reactions following the administration of this agent and the hospital stay per patient was considerably shortened.

In 38 cases with the thrombotic process limited to the lower legs, there were no deaths and the average length of time that the patients were confined to bed after treatment was begun was six and four-tenths days. In 13 cases which were not seen until the disease had spread to the thigh there was 1 death from pulmonary embolism. In the other cases no complications occurred and the average time in bed after heparinization was begun was seven and three-tenths days.

J. M. MORA, M.D.

**Cardozo, E. L.: Changes of Blood Volume, Hemoglobin, and Serum Protein Caused by Large Transfusions.** *Acta med. scand.*, 1941, 109: 397.

Thus far there is little agreement as to the quantity of blood which may be transfused harmlessly. While some authors consider a transfusion of more than from 300 or 500 cm. to be dangerous, others more and more insist on giving larger amounts, up to from 1 to 2 liters. In part this discrepancy may be attributed to the technique employed, for larger volumes will be tolerated better when the transfusion is given more slowly and when better safeguards are observed against reactions. The total blood volumes average 5 liters and a transfusion of ½ liter will increase the hemoglobin content only by 10 per cent. In order to cause an important increase in the hemoglobin content, transfusions of from 1 to 2 liters are necessary. The question arises whether symptoms of overfilling of the vascular bed will appear by transfusing these large quantities. In the experience of the author, from 1 to 2 liters of blood can be transfused safely to an adult if the speed does not exceed 500 cm. per hour. This leads to the assumption that some mechanism of adaptation must exist, either a general dilatation of the vascular bed, or a quick elimination of the transfused plasma and erythrocytes from the vascular bed.

In order to investigate this question, the author determined the plasma value, the hematocrit value, and the percentages of hemoglobin and serum protein before and after a large transfusion. These values were also determined in the accurately measured volume of transfused blood. The author presents in detail the technique used in these studies. There were 3 groups of patients, as follows:

The first group was comprised of 8 patients with severe secondary anemia as a result of prolonged hemorrhage from the stomach, gut, bladder, or uterus. Each patient received 11 transfusions. Another group included 7 patients with moderate anemia and markedly lowered serum albumin, such as occurs in ulcerative colitis, chronic suppurative infections, sepsis, and malignant growths. The third group was comprised of 3 patients with shock which had occurred following an acute large hemorrhage, trauma, operation, or some other condition.

The author concludes that after a large transfusion the circulating blood volume is soon regulated according to requirements. If the blood volume is normal before the transfusion, the transfused plasma leaves the vascular system; if there is a shortage of the circulating blood, most of the transfused plasma is kept inside the vessels. By this regulating mechanism, overfilling of the vascular bed is prevented and an insufficient filling can be restored. This permits the transfusion of large quantities (from 1 to 2 liters) of blood in cases in which much blood is required to restore a great shortage of hemoglobin.

The rise in the number of erythrocytes in the vascular bed was, on the average, equal to the transfused quantity. The smaller the circulating blood volume before the transfusion, the larger the proportion of the transferred plasma water and protein which was retained in the vascular system. On the average, the entire loss of fluid in the group of patients with severe secondary anemia was 106.6 per cent; in the group of patients with moderate anemia and markedly lowered serum albumin it was 47 per cent. In the third group of patients, those with shock, no plasma water was lost. In the cases of 4 patients in the first group with a normal plasma volume before transfusion, not only all of the infused plasma left the vascular system, but also part of the original plasma was replaced by the transfused erythrocytes.

HERBERT F. THURSTON, M.D.

**Spassokoukotzky, S., and Vinograd-Finkel, F.: Analysis of the Causes Leading to Fatal Accidents after Blood Transfusions and Their Prophylaxis.** *Chirurgia*, 1941, 1: 3.

In this report the authors present an analysis of the causes which have led to fatal accidents after blood transfusions given for various reasons in 28 different hospitals of the Union of Soviet Socialist Republics. While among the 15,000 blood transfusions given prior to 1935, 55 deaths had occurred (0.36 per cent), during the period from 1935 to 1939 only 70 deaths (0.02 per cent) in 382,000 blood transfusions were registered. In discussing the causes which had led to the fatal accidents the authors distinguish cases in which a technical error had occurred from those in which incompatible blood was transfused when the common laboratory methods were inadequate.

In 4 cases death was due to an air embolus. This high percentage, according to the authors, is indicative that in the development of air emboli, the pressure under which air enters the circulation is of more importance than the amount of air injected.

Fourteen deaths (20 per cent) were due to faulty technique or neglect in cross-matching and in the determination of the blood groups.

In 14 more cases contamination of the blood or some other break in the technique of blood collection and blood preservation had occurred.

In 54 per cent of the deaths no technical error could be demonstrated, and the fatal accidents in the second group were due either to contraindication of the blood transfusions or to a special proteinic constellation of the recipient which was incompatible with the blood of the donor and not detectable by the common laboratory methods.

For the transfusions which were reported, fresh, preserved, blood from placentas and corpses was used:

| | No. of transfusions | Deaths |
|---|---|---|
| 1. Preserved blood (2–6 days old with 6 per cent sodium citrate) | 235,000 | 27 |
| 2. Fresh citrated blood | 135,000 | 10 |
| 3. Placental blood (8–21 days old) | 8,000 | 11 |
| 4. Blood from corpses (8–21 days old) | 4,000 | 4 |
| Total | 382,000 | 52 |

Five children were transfused with blood from the same blood bank, which was contaminated with the nonpathogenic bacteria subtilis. In all 5 cases death occurred, and the authors assume that in these cases the normal serum proteins were transformed into toxic substances by the action of the bacteria.

No conclusions could be drawn as to which blood group had given the greater number of fatal accidents.

Certain conditions (severe liver cirrhosis, septicemia, severe cachexia) represent contraindications for transfusions, inasmuch as severely damaged organs (liver, kidneys) are being subjected to a severe strain. In these cases the authors suggest the use of defibrinated blood, which causes fewer transfusion reactions; or the injection, prior to the transfusion, of 5 cc. of the same blood that is to be used for the transfusion.

There was, however, a group of 23 patients in which neither technical errors nor clinical contraindications could account for the fatal outcome. In these cases, the authors admit, there was a previous sensitization which caused a fatal anaphylactic shock during or after the transfusion. The allergic factor itself, however, cannot account for all deaths in this group, and the authors think that in some individuals there may be special blood proteins which cannot be demonstrated with our present laboratory methods, and which are able to cause these fatal accidents.

GEORGE SIMMONS, M.D.

**Beattie, J.: Changes in Hemoglobin Concentration and Plasma Specific Gravity Following Plasma Transfusions.** *Brit. M. J.*, 1942, 1: 459.

The method of calculating pretransfusion blood volume by the determination of the reduction in

the hemoglobin concentration of the blood following the rapid transfusion of a known quantity of plasma is based on several assumptions, viz., (1) that complete mixing of the plasma with *all* of the circulating blood takes place; (2) that the number of red cells in circulation during the transfusion and mixing remains constant; (3) that the plasma volume after transfusion and mixing is equal to the volume of plasma before transfusion plus the volume of plasma transfused; and (4) that when the hemoglobin concentration returns to its pre-transfusion level the volume of plasma which has been transfused has been eliminated from the blood stream.

The author questions these assumptions on the basis of his observations, which were made during an investigation of the physical and chemical changes in the blood after the transfusion of plasma regarding variations in hemoglobin concentration and plasma protein content of the blood found in experimental animals during the first hour after rapid plasma transfusions.

He concludes that the assumption that only protein-free fluid moves into or out of the blood stream during the period of observation is untenable. Plasma transfusions in normal animals and probably also in man cannot be used to estimate blood volumes. Intravenous transfusions of plasma into anesthetized animals are followed by changes in the hemoglobin concentration and plasma protein content which cannot be explained on the basis of a simple mechanical mixing of the transfused plasma with the circulating blood. The formation of surface films of plasma in capillaries opened up to receive the transfused plasma reduces the amount of plasma available for dilution of the circulating blood and leads to high hemoglobin values with consequent high estimates of blood volume. Movement of protein-free fluid from the blood stream cannot account for the observed changes in plasma serum globulin and hemoglobin concentration. Movement of plasma proteins probably occurs simultaneously with this fluid shift.

JOHN E. KIRKPATRICK, M.D.

**Hayward, G. W., and Jordan, A.: Changes in the Blood Volume Following Transfusions of Serum or Plasma, and the Fate of Injected Protein.** *Brit. M. J.*, 1942, 1: 462.

The widespread use of intravenous serum or plasma recently has aroused interest in the effect of these transfusions on the blood volume and the fate of the transfused protein.

Observations were made on a series of patients with peripheral vascular disease who were receiving weekly injections of serum or plasma. The changes in the blood volume and the methods used to determine the changes and the fate of the serum protein are discussed in detail.

In was found that following the transfusion of from 800 to 1,200 cc. of serum or plasma the initial blood volume was regained in from two to five days.

The added serum protein was removed from the circulation; none was lost as protein in the urine; and the concentration of the blood to its original volume produced no increase in the plasma protein figures. The ultimate fate of the protein is still uncertain. JOHN E. KIRKPATRICK, M.D.

# SURGICAL TECHNIQUE

## WAR SURGERY

**Practical Scientific Problems in Wartime Russia. (Cable report by Prof. Grashchenkov.)** *Brit. M. J.*, 1942, 2: 348.

"When the Germans attacked Russia the personnel of the U.S.S.R. Institute of Experimental Medicine gave up their long-term theoretical researches in favour of practical scientific problems." At a meeting in August the subjects discussed were "the treatment of injuries of the nervous system and the control of certain epidemic diseases."

*Cerebral lesions.* In six months, 600 cases of compound wounds of the head were treated in the neurosurgical clinic of the U.S.S.R. Institute of Experimental Medicine, "in close collaboration with a mobile field hospital specially staffed and equipped both surgically and radiologically for neurosurgical work." The use of sulfonamides was strongly favored as a result of this experience; sulfanilamide, sulfapyridine and sulfathiazole in varying mixtures and proportions were employed, the choice depending upon the types of organisms discovered on routine culture of the wounds. Brain abscesses were observed to develop without at first giving rise to symptoms.

"The treatment of aphasia and other focal brain lesions was carried out at a branch clinic of the Institute under Prof. Luria. Methods have been worked out for the restoration of normal functions. Prof. Kupalov, a pupil of Pavlov, considers that damage at the highest level interferes with the synthetic action of large areas of the cortex, with the production of torpor and neurotic complexes. Prof. Rosenthal, another pupil of Pavlov, has reported on the elaboration of temporary conditioned reflexes in a person with brain injuries. By means of this method he is trying to determine the degree of disturbance of the cortical processes and to estimate by the speed with which the temporary conditioned reflex develops the degree of recovery of function which may be expected. Other members of Pavlov's laboratory have employed prolonged sleep therapy by means of drugs, and have found this method particularly effective in cases of cerebral contusion. Details of the methods employed are not given in Prof. Grashchenkov's report.

"*Peripheral nerve lesions.* Prof. Lavrentjev has studied various aspects of the regeneration of peripheral nerves and claims to have found evidence for the 'chemico-motor role' of the peripheral segment in attracting nerve fibres to itself. Investigating the value of fixed pieces of spinal cord as transplants for bridging gaps after nerve lesions, he finds that the best results are obtained by using formalinized nerve, since this 'quickly vascularizes itself and delays the proliferation of the connective fibrous elements of the scar.' No details are given of functional recovery in animals or men after this procedure. The only means found for accelerating nervous regeneration was heat. For preventing the outgrowth of nerve fibres and the formation of neuromas Lavrentjev suggests ligation of the vessels of the nerve. Prof. Magnitsky presents a study of the chronaxie of peripheral nerve after full and partial disturbance of its functions. Prof. Orekhovich has studied the metabolism of degenerating and regenerating nerves and finds special histolytic enzymes at work during regeneration.

"*Louse-borne typhus.* Reports on investigations in infective diseases are of equal interest. Levkovich reported on the work, carried out at the laboratory of Prof. Smorodintsev, on the specific prevention and early diagnosis of typhus of the classical louse-borne type. For the first time it has been possible to carry out, in an epidemic area, a large-scale investigation of the effectiveness of a vaccine prepared according to a modification of the Weigl technique at the All-Union Institute of Experimental Medicine (it will be remembered that the original Weigl vaccine was prepared from the intestines of infected lice). At the same time the Cox vaccine, prepared from growths of *Rickettsia prowazeki* in the yolk sacs of developing fowl embryos, and treated with phenol and formalin, was tested under epidemic conditions. This vaccine had been supplied by the representatives of the American Red Cross. In animal experiments these vaccines were compared with the Durand-Sparrow vaccine made from the lungs of infected laboratory animals; it was established that the Cox vaccine is the most effective and the simplest to prepare.

"In the same laboratory, work was carried out on the early diagnosis of typhus by means of a complement-fixation test performed at low temperature. This reaction is stated to be very sensitive and strictly specific, giving positive results as early as the first or second day of illness. The importance of such a result can hardly be over-estimated. Bengtson (*Publ. Hlth. Rep.*, Wash., 1941, 56, 649) in America has obtained positive results in endemic (flea-borne) typhus with a complement-fixation test in which she used as antigen a suspension of Rickettsiae; the reaction was positive as early as the sixth or seventh day of onset, and followed a course similar to that of the Weil-Felix reaction. A somewhat similar result was obtained in Q fever (*Publ. Hlth. Rep.*, Wash., 1941, 56, 327) but these reactions were performed at 37° C. The earlier results in the Russian work are presumably due to the low temperature employed. These findings recall the work of Kahn (*Arch. Derm. Syph.*, 1940, 41, 817) who has found that the reaction which goes by his name is intensified if carried out at 1° C. In this case, however, Kahn considers that the strong reactions at low temperatures are of 'general biologic type' rather than 'syphilitic type.' A fuller account of the Russian work will be awaited with interest.

"*Insecticides.* Prof. Petrishcheva has investigated the possibility of using 'local insecticide material' to be found in waste and cheap semi-processed products of the chemical industry and also in wild plants. Thus, for example, in one of the Siberian regions nearly 150 types of moss were found to have varying insecticidal powers, 50 of them in a high degree.

"A number of insecticidal substances were tested against lice, and certain preparations were found to be highly effective when applied to clothing, or for the disinfestation of transport vehicles, including railway carriages. Details are not given in this communication, but Rossiysky (*Soviet Med.*, 1940, No. 3) has previously written of the use of 'nassecamoyad,' a 10 per cent solution of kerosene-carbolic soap, and of 'solvent,' a product of benzol and toluol, derived by fractional distillation and retaining their highest homologues. He states that the former destroys lice quickly and does not irritate the skin; its protective action lasts 2 to 4 days. The fumes of 'solvent' destroy lice in 9 to 12 minutes; this substance causes, apparently, no harm to human skin. Russian workers have not recently made much reference to the heat treatment of clothing, but no doubt this is carried out, the latest researches having been directed towards the preparation of efficient insecticides. Chasovnikov (*Soviet Med.*, 1940, No. 9) has written of the use of 'solvent' in the field.

"*Other researches.* Prof. Tokin made an interesting report on a bactericide of plant origin. As a result of ten years' research with the help of a group of assistants he was able to establish that many plants have substantial bactericidal qualities, and that strong bactericidal principles are found in the ordinary turnip-like onion, garlic, radish, and probably in citrus plants. These bactericidal qualities are discernible in a vaporized state. Five, and in some cases three, minutes of the vapour of these plants is enough to inhibit and sometimes to kill certain organisms, such as streptococci and staphylococci and intestinal bacilli."

**Gordon, R. M., and Seaton, D. R.: The Treatment of Scabies.** *Brit. M. J.*, 1942, p. 685.

The authors conclude that in scabies preliminary washing and scrubbing of the skin facilitate the sarcopticidal action of the drugs which were tested. The vegetable oil used as a vehicle for the drugs allowed them to penetrate the skin to a satisfactory depth within fifteen minutes after their application. Such a vehicle should prove more satisfactory than semisolid mineral ointment bases.

A single application of any of the drugs tested produced degenerative changes in almost all of the mites within three days, but a proportion of the eggs still remained apparently unaffected. It was suggested, therefore, that a second application of the drug should be made after an interval of a week, by which time any eggs which survived the first application would have hatched.

The results of the authors' investigations of animal scabies supported the generally accepted view that the larval mites leave their burrows, wander on the surface of the skin and clothing, and can be transmitted by the garments. Until the frequency with which this occurs in human scabies has been determined it would be unwise to dispense with the disinfestation of undergarments and bedclothes.

No significant difference was detected between the actions of benzyl benzoate and dimethylthianthrene (mitigal). Tetraethylthiuram monosulfide was more rapid and more lethal in its action than either of the first two drugs; its superiority was such that it is worthy of a trial in human scabies.

WALTER H. NADLER, M.D.

**Howell, C. A. H.: Dyspepsia in the Army in 1940 and 1941.** *Brit. M. J.*, 1942, 1: 692.

A comparison of statistical data of patients suffering from "dyspepsia" in a large "static" hospital in England is presented. These data are compiled from approximately 1,000 admissions for each of the years, 1940 and 1941. It was found that a slight increase (2.8 per cent) occurred in 1941 over 1940 in dyspepsias of all types. This increase resulted from a rather marked increase in neurotic dyspepsia (12.4 per cent), the other types of dyspepsia having remained fairly constant, or, as in the case of peptic ulceration, the incidence having even fallen.

The author discusses the disposition of the neurotic dyspeptic patient, and concludes that he should be taken out of the hospital at the completion of his investigation, and not allowed to return.

LUTHER H. WOLFF, M.D.

**Stonham, F. V.: The Late Treatment of War Wounds.** *Med. J. Australia*, 1942, 1: 611.

In a large number of cases in which the wounds were excised and sulfanilamide was inserted or was given by mouth, primary healing was not secured. In the case of old wounds, in which infection was localized and the patient was in good condition, showing no pyrexia, or at the most had a slight evening rise in temperature, chemotherapy was of little value. Local application did not, as a rule, appear to accelerate healing. Some of the men with septic wounds already had been given courses of chemotherapy without benefit before they were received at the author's station. In those cases in which the infection was not under control and fever and inflammation of the lymphatics and regional lymphatic glands was present, sulfanilamide given orally was often of distinct and striking value. The treatment of war wounds is primarily surgical, and the sulfanilamide group of drugs are, at the most, useful adjuvants.

Bipp enabled many wounds to be closed by primary or secondary suture, and it gave good results in wounds in which infection was established. In the comparatively small proportion of cases in which it was used, the conspicuous excellence of the results was noted. In a number of wounds of the hands and feet, in process of healing or having healed, the bismuth could still be seen in x-ray films. Several pa-

tients with large wounds of the limbs, which had been treated by a combination of bipp and the "closed plaster" method, arrived in excellent condition as regards both the wound itself and the patient's well-being. The wounds, often extensive and deep, granulated well, there was a minimum of discharge, and the plaster casts had less tendency to become foul. Some patients showed no ill effects, even though bipp had been inserted in quantities sufficient to prevent roentgenography through the plaster case. At the hospital bipp was employed in wound dressings, especially for those wounds in which bone was exposed.

Urea gave excellent results, especially in foul and sloughing wounds. Urea treatment can with advantage be combined with the "closed plaster" method. Urea has some deodorant power.

Rapid healing of wounds sometimes follows accidental infestation with maggots. Allantoin is said to be excreted by maggots. It offers considerable promise if it will give the same results as the maggots themselves.

The "closed plaster" method of wound treatment as the basis of treatment of all infected or potentially infected wounds of the limbs not only gave highly satisfactory results but was labor-saving and inexpensive. It was agreeable to the patient and was ideal for transport of the wounded. The method must be employed intelligently and the best results are secured when the practice closely follows the original Winnett-Orr technique.

When wounds are, or become, superficial, rapid healing follows the production of a protective crust by means of boric-acid powder and hot air.

Direct contact of cloth dressings impedes healing.

Some of the most troublesome cases are those of injury to the upper limb.

Injuries to the fingers, hand, and wrist are common. Excision should be thorough, and every effort should be made to secure primary healing. A "through-and-through" wound of a finger with loss of substance of a metacarpal bone or phalanx is almost certain to be complicated by loss of both flexor and extensor tendons. In these cases, if primary healing is secured, the patient is left with a useless, stiff finger, which is an encumbrance. If the wound becomes infected, the function of the entire hand is jeopardized. One hesitates to sacrifice the thumb; but poor results follow prolonged convalescence in those cases in which there is an infected wound. If there is no prospect of securing primary union with perfect function, the aim should be to excise the wound and include the fractured portions of the bones, and to secure healing with ankylosis in a useful semi-flexed position. Infected wounds of the carpus may be treated in "closed plaster" in the optimum position in case ankylosis should follow, with the hope that stiffness will not be complete. Secondary hemorrhages from the radial or ulnar arteries occasionally occur and should be watched for in infected fractures. Fractures of the humerus caused by bullets, high explosive shells, and bombs are often much comminuted, and the patients arrive with the bones in bad position. The author secures as good alignment as possible without undue manipulation in infected cases, and leaves the limb in a plaster spica. Union, especially when multiple small fragments of metal are present, tends to be very slow. Damaged nerves are operated on as soon as possible after the wound has healed, especially when only the soft parts are injured—that is to say, within a few weeks. The danger of stirring up infection is very small. In many cases exploration is rewarded by the discovery of foreign bodies or spicules of bone impinging on, or actually transfixing, the nerve trunk. Rapid cures in partial lesions have followed neurolysis and incising of the nerve sheath. Some patients have had improved movements and freedom from pain in a few days, after several weeks of expectant treatment had resulted in no perceptible change.

Wounds of the lower limb were less troublesome than those in the upper extremity. Conditions like foot drop and stiff joints, though common enough, are largely avoidable, as they are due to faulty technique. Wounds of the soft parts of the thigh are seldom troublesome although one convalescent patient developed a sudden fulminating, fatal gas gangrene of the entire leg a few days after the removal of a piece of metal from the adductor magnus. With regard to bullets and pieces of shell, or bomb, the practice, generally speaking, is to let alone small ones that are causing no trouble. Large ones likely to give trouble or actually giving it are removed as promptly as conditions warrant; only those in inaccessible situations are left. When irregular pieces of shell and bomb are removed, it is often astonishing to observe how much gross dirt is enmeshed within their clawshaped processes, and yet the wound has remained healed.

The guillotine amputation still appears to be widely practiced. These stumps take a long time to heal, because often the blood supply is poor, and they are apt to develop a ring of fibrous tissue, which further impedes the vascularity of the granulating surface. Grafts do not take well. Convalescence is prolonged and reamputation before healing, if complete, is not devoid of danger. If flaps of some sort could be devised at the time of operation, and, if necessary, closed by secondary suture, secondary amputation in order to make the stump conform to the requirements of the artificial limb maker could be undertaken earlier, with the saving of much avoidable anxiety and discomfort to the patient and many weeks in the hospital. It is improbable that the fashioning of simple equal flaps or a circular amputation would appreciably aggravate the shock of operation. The guillotine amputation may at times be imperative; but it is questionable whether it is ever correct to describe it as a "method of choice."

Elaborate physiotherapeutic apparatus as an aid to final restoration of complete function is not absolutely indispensable.

Prevention of infection, removal of foreign bodies, immobilization of the wound with purposeful compression, and the general care of the patient as far as nutrition and freedom from the disease is concerned, aid in the early healing of wounds.

MANUEL E. LICHTENSTEIN, M.D.

**Goldschlag, F.: Experiments on the Improvement of the Treatment of Mustard-Gas Lesions of the Skin.** *Med. J. Australia*, 1942, 1: 620.

Mustard gas was responsible for 27,711 of the 36,965 gas casualties in the American Army in the First World War, and 80 per cent of the 160,970 gas casualties in the British Expeditionary Force. Mustard gas is the most important vesicant gas. Contact with water decomposes it hydrolytically. With hypochlorites it forms nontoxic sulfoxides. In order to secure its decomposition and detoxication in the human skin, bleaching powder (calcium hypochlorite) is applied either in pure powder form or incorporated in ointment, paste, or petroleum jelly. The more delicate and the less pigmented the skin, the greater is its sensitivity. Especially susceptible are the eyelids, the genitalia, the inguinal region, and the anus. As a rule, solutions of a strength of 1 per cent and upward are harmful to most individuals of the white races. In a subject with good pigment-forming capacity, it was found that painting the skin of the thighs with a 1 per cent solution regularly gave an erythema at the site of contact within from six to ten hours. The erythema may disappear from man and animals in about forty-eight hours or may undergo further changes. Premonitory symptoms, such as burning and itching, may be absent. In the present investigation the skin of the ears of rabbits was found to exhibit individual variations. While many animals were resistant, a concentration of from 1 in 80, to 1 in 50 regularly produced blisters. These did not appear before a period of twenty-four hours—usually later. The contents of a well-filled blister are clear. The blisters appear to be painful and, if let to themselves, burst on the third or fourth day, with the formation of superficial erosions or deeper ulcers. Firmly adherent, yellow impetigo-like crusts develop later. Further progress is slow and generally lasts for weeks, until a healthy granulation with vascular tissue appears. After from four to six weeks the lesions generally heal and a superficial scar with telangiectases and irregular pigmentation is the result. This stage reminds one vividly of a chronic radiodermatitis.

Deeper lesions lead to perforation of the ears of the animals. The defect is not filled up; the margin of the perforation heals and a clear-cut, rectangular area from which tissue is lost is evidence of the entire destruction of all layers. The skin reactions that go no further than erythema formation are characterized by a pronounced purple discoloration, which persists for a short period and is replaced by a pronounced brownish or coppery pigmentation, accompanied by superficial peeling. The usual routine treatment is the cleansing and drying of the skin and the application of bleach. Calcium hypochlorite is suitable for the decontamination of inanimate objects and places. The application of this compound to the skin, however, has many disadvantages, including the frequent production of severe dermatitis.

In order to avoid this the application of chloramine is recommended. It is applied either in the form of an ointment or in solution. For mucous membranes a concentration of 0.1 or 0.2 per cent is sufficient. Chloramine forms a nontoxic compound with the "gas."

One of the most dangerous properties of mustard gas is its great power of penetration. When hydrolysis takes place, the generation of hydrochloric acid in tissues is possibly responsible for much of the damage and for the pronounced diminution of resistance against secondary infection. It appears that either the reaction requires a certain time to develop or it is reversible in its initial stages. Thus therapy should aim not only at the neutralization of gas residues adherent to the surface of the body, but also at the destruction of that part of the gas which has already penetrated. This may be done by the use of a "wetting agent." A "wetting agent" is defined as a substance which, by means of its effect in lowering the interfacial tension, increases the penetration of the skin and acts as a detergent or emulsifying agent. As a group the esters of sodium sulfosuccinates have been found to be the most powerful wetting agents yet described. The combination of active gas-destroying agents with neutral yet physicially active substances appears to have distinct possibilities. Aerosol O.T. dry 100 per cent forms a clear, soluble colloid with water in a concentration of 1 per cent. Glycerin and sugar promote its solubility. In higher concentration it forms a slimy gel. It is used in the cosmetic industry in the preparation of viscous lotions, creams, and shampoos. It is absolutely neutral and stable, and is a wetting agent of the highest surface activity. It lowers the surface tension of water from 72 to 26. It is fairly soluble in a great number of organic solvents.

An ointment consisting of 0.2 per cent chloramine and 8 per cent aerosol is well tolerated in most instances. It neutralized the effect of the gas in concentrations of from 1 in 80 to 1 in 50 in each of 16 experiments when applied not later than thirty-five minutes after exposure. In a few cases application even after the lapse of one hour was effective. When applied after an hour the effect was usually doubtful. In 3 cases only an erythema developed when blisters occurred in the controls; in 5 others typical blistering ensued. This ointment causes little, if any, irritation in the normal human conjunctiva.

The author recommends that each first-aid post should have available, besides a stock of 0.2 per cent chloramine solution, one of chloramine aerosol ointment (aerosol may be replaced by another wetting agent.) Persons in special danger of exposure to the gas should carry a small pot or tube of the ointment with them. MANUEL E. LICHTENSTEIN, M.D.

**Hoffmann, R.: Closed Osteosynthesis, with Special Reference to War Surgery.** *Acta chir. scand.*, 1942, 86: 235.

The author describes and illustrates an ingenious apparatus for the closed reduction of fractures, based on the old "Fixateur Externe" of Lambotte. It can be applied to all the long bones (excepting the fibula) and to such joints as the elbow, knee, and tibiotarsal joint. The apparatus requires the use of transcutaneous screws and nails, but the danger of infection is no greater than that with the use of Kirschner's wire.

From the standpoint of war surgery, this device permits immediate fixation and transportation, mobilization of neighboring articulations, and easy accessibility of the remainder of the extremity for the treatment of associated wounds of the soft parts. It may be used also in the treatment of compound fractures and in combination with plaster casts.

J. M. Mora, M.D.

**Gordon-Taylor, G.: On Amputation: Ten Commandments.** *Lancet*, Lond., 1942, 242: 669.

The author presents "Ten Commandments" for the performance of primary amputation in war surgery. They are:

1. Seek a second expert opinion before amputating.
2. Gas and oxygen is the anesthetic of choice.
3. Avoid the use of a tourniquet.
4. Use a long, sharp amputating knife—not a small scalpel.
5. Do not crush, ligate, or inject nerves; blood vessels are best ligated with nonabsorbable suture.
6. Use speed. Amputations should be performed in minutes, not hours.
7. Transfixation-flaps may be used in exceptional cases as they add to the speed of amputation.
8. Use the Thomas splint instead of plaster when necessary.
9. Close the stump loosely and insert small rubber drains at each corner for twenty-four hours as oozing may take place from small vessels after recovery from shock.
10. Avoid massage of the stump.

Luther H. Wolff, M.D.

**Goulston, S. J. M.: A Regimental Aid Post in Tobruk.** *Med. J. Australia*, 1942, 1: 494.

Goulston presents a certain regimental aid post in the Fortress of Tobruk during the German-Italian siege in April, 1941. The post was situated in a cave cunningly concealed beneath an old fig tree which formed a conspicuous landmark in an otherwise completely bare desert. The cave was completely underground, and consisted of 3 rooms, 2 of which were large and spacious, and the third small and compact. Two airholes made artificial lighting in the daytime unnecessary.

The site had 5 advantages: (1) it was in the center of the battalion area, about equidistant from all posts; (2) it was close to a good dirt track road, by means of which the truck could reach all company headquarters; (3) it was a roomy, well protected site, capable of holding from 25 to 30 wounded men; (4) a cookhouse was provided and a cook was on hand at the regimental aid post; (5) it was close to battalion headquarters and had direct telephonic communication with battalion headquarters and with all posts.

The site had 2 disadvantages: (1) it was under enemy observation and shelling, and (2) it was impossible to bring the truck or ambulance to the aid post during daylight except in extreme emergency.

In every post was a stretcher bearer who had been trained also as a medical orderly. At 3 points were forward regimental aid posts manned by a noncommissioned officer orderly, who was more experienced than his fellow in the post, and who decided whether an allegedly sick man would be sent to the main regimental aid post or return to his section. The ration trucks collected the sick men at night and conveyed them to the main regimental aid post, where they were either admitted to the sick bay or transferred to the nearest field ambulance. During the day, or periods of the night, wounded were collected by the regimental aid-post truck or were carried by a party of stretcher bearers.

The main difficulties encountered in the maintenance of hygiene were: (1) lack of water; (2) the fly or flea menace, and ticks; (3) the disposal of excreta and refuse; (4) cooking; and (5) boredom and inactivity. Lack of water was always a serious problem and men were rationed to from ½ to 1 gallon of water per day for all-purpose use. The lack of water for washing was offset by the following measures: (a) sea bathing when out of the line; (b) transportation of sea water in oil drums to forward posts; (c) small company distillery plants, which yielded from about 80 to 100 gallons of fresh water per day; (d) exposure of the body to the sun; and (e) the use of sand and wood ash to clean dixies. These practices were sufficiently successful to keep the incidence of lice and scabies down to a minimum. The essence of the problem of the fly-intestinal disease menace was the efficient disposal of excreta and refuse. To prevent the fly from breeding, trench latrines were erected in convenient spots and the men were educated always to use them. Whenever possible, refuse was buried in areas allotted for this purpose; otherwise it was burned. Fleas and ticks infesting the cave were kept down by cleansing, and by the liberal use of flea powder and disinfectant. Diarrhea responded well to the standard forms of treatment. Cooking was centralized for the entire area, and the result was a better standard of cleanliness and supervision, which could be exercised in a fairly safe area. To counter boredom and inactivity, active reconnaissance and fighting patrols were instituted over the whole perimeter, which gave the defenders the initiative and the feeling that they were superior to, and could hit back at, the enemy. This was a big contributing factor to the high morale which existed throughout the siege. Edwin J. Pulaski, M.D.

**Garvin, L. D.: The Work of Our Surgical Detachment.** *Woen. san. delo,* 1940, No. 10, 70.

The author reports on the medicosurgical work performed during the Russo-Finnish war by a surgical detachment of which he was the director. The material offered is eminently statistical, in so far as Garvin endeavors particularly to establish the frequency of certain injuries as observed in modern warfare and the most frequent sites of such injuries.

It appears that 67.4 per cent of all the cases treated presented injuries due to gun bullets; 27.6 per cent of all the casualties observed were due to fragments of shells, while only 5 per cent were injuries caused by mines.

As far as the site of the injury is concerned, the upper extremities were injured most often (40 per cent) and the lower extremities came next (25 per cent), while the frequency of injuries to other parts of the body was considerably smaller: chest, 10.8 per cent; face, 5.5 per cent; skull, 5 per cent; abdomen, 4.4 per cent; pelvis, 5.2 per cent; neck, 1.7 per cent; spine, 2.1 per cent; and external genitalia, 0.25 per cent.

The fact that injuries to the extremities were very predominant among the casualties observed can easily be explained by assuming that injuries to other parts of the body usually are of a more severe character and that such casualties either could not be transported at all or were evacuated to hospitals farther behind the lines.

Of all the fractures observed from 33 to 35 per cent were fractures of the upper and about 27 per cent were fractures of the lower extremities. As far as the depth of the injuries was concerned, 38 per cent of the skull injuries, 48 per cent of the chest injuries, 6 per cent of the abdominal injuries, and 9 per cent of the cervical wounds were penetrating. In 38.2 per cent of all the injuries to the face, the lesion was a fracture of the jaw caused by firearms.

GEORGE SIMMONS, M.D.

## OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

**Arnott, G. M., and Young, W. F.: Postoperative Administration of Fluids to Children.** *Lancet,* Lond., 1942, 242: 523.

The fluid requirements of children in the postoperative period have been extensively studied by Arnott and Young. It was found that degrees of dehydration ranging from mild to moderate and severe were relieved by volumes of fluid representing from 3 to 6 per cent of their body weight. It is necessary not only to relieve the dehydration, but also to give the patient sufficient fluids to cover his normal losses. Because the basal metabolic rate, the blood volume, and the kidney function are related to the surface area rather than to the body weight, a formula, based upon these factors, was used to estimate the normal daily fluid requirements of children. A table is given which shows the daily fluid requirements of children of different ages, of average weight and height, from six months to seven years. Condensed, it is as follows: 750 cc. at one year; 1,000 cc. at three years; 1,500 cc. at eight years; 2,000 cc. at twelve years; (average adult: 3,000 cc.).

A series of cases was discussed, and the postoperative treatment of 6 children whose fluid requirements were assessed on basic physiological principles was given in detail. Most of these patients had suffered from appendical abscess which was given the usual surgical treatment, and it was concluded that it is better to leave a sick child to his own devices in taking fluids than to drown him in large volumes of saline solution; his tissues are in no way aided in overcoming infection by the substitution of edema for dehydration, and the aim of every therapeutist should be to restore the normal fluid intake and output. The patient's progress, however, is the best indication of the effect of treatment.

In the administration of intravenous fluids, it was shown that the use of 4.1 per cent glucose in 1/5 normal saline solution makes an isotonic solution, provides calories, and also combats any ketosis. The authors used this type of solution to cover the normal daily requirement and any fluid shortage due to starvation. They reserve normal saline solution for the relief of dehydration caused by vomiting, and to replace in approximately equal volume any postoperative loss of intestinal juices from emesis or drainage.

STEPHEN A. ZIEMAN, M.D.

**Muirhead, E. E., Hill, J. M., and Ashworth, C. T.: The Use of Human Plasma-Protein Solutions in Surgery.** *South. Surgeon,* 1942, 11: 414.

One of the important problems in surgery concerns the maintenance of the proper amount and composition of the various fluids in the body. These fluids are intracellular and extracellular. The intracellular fluids make up about 50 per cent of the body weight, and have a potassium ion as their chief cation. The extracellular fluids have a preponderance of sodium ion and comprise 20 per cent of the body weight. The latter have two major subdivisions: those located outside of the blood vessels and between the cells are called the interstitial fraction; and those located within the blood vessels are called the plasma fluid.

The plasma fluid is a circulating fraction which has to do with the distribution of certain substances within the body. It acts as a medium for red-blood-cell transport, and conveys food substances, hormones, antibodies, water, and electrolytes to the various parts of the body. It also is concerned with the removal of waste products and the maintenance of the acid-base balance. The interstitial and intracellular fluids are noncirculating in nature. They act as reservoirs and mediums of exchange. The intracellular fluid receives dissolved substances brought to the cell, furnishes a medium for cell metabolism, and helps in discharging waste products and secretions from the cell.

In certain surgical conditions, alterations in these various fluids take place. There may be an increase

or decrease in the volume. Such changes may be of little consequence, or they may be very dangerous, even fatal. A few examples are hemorrhage, anoxemia, Addison's disease during crises, intracellular edema and acute parenchymatous degeneration, water intoxication, freezing shock, experimental fever, severe hypoproteinemia, and advanced dehydration associated with pancreatic or biliary fistula. These examples demonstrate how, in disease, the water in the body may be shifted from a location where it is vital, to a place where its presence in greater quantity may not be needed or may even be deleterious. These alterations in the fluid distribution in the body can be influenced and, to a large degree, controlled by the proper use of intravenous plasma-protein therapy. Concentrated plasma is not only able to shift fluids from the interstitial reservoir into the blood stream, but it is also able to draw fluid out of the cells. For this purpose dry plasma is superior to liquid plasma. This superiority is due to the fact that indefinite and safe storage at room temperature is possible and to the fact that the choice of concentration is available. Concentrated, normal, or diluted plasma can be prepared from the dry product by varying the amount of water or saline solution.

Traumatic and surgical shock is effectively treated with concentrated plasma or serum, which should be rapidly administered by intravenous injection. The main aim of shock therapy is to replace the lost blood volume early, and thus accelerate the circulation before these changes are irreversible. Obviously, the more rapid the replacement, the more efficient is the therapeutic agent. The plasma-protein solution offers more in shock than any other solution because of the protein content. The proteins tend to hold water within the blood vessels and by this means maintain the circulation. These plasma-protein solutions should be administered in one of three forms: as diluted plasma, as normal plasma, or as concentrated plasma. In the opinion of the authors, normal plasma is more effective than diluted plasma in the treatment of shock because its protein content is greater per unit volume. Even better than normal plasma is concentrated plasma because it exhibits greater therapeutic effectiveness. A few seconds after injection it reaches the capillary beds and in this location it pulls water from the tissues into the blood stream because of its great protein concentration. In the normal individual this shift of water is but an accentuation of the physiological mechanism whereby the vital circulating plasma volume is defended by the tissue fluid reserve. The use of concentrated plasma is not only entirely physiological in its action, but constitutes a corrective force tending to reverse this shock mechanism. There is also evidence that water is given up by swollen cells with a return to a more normal state. These changes are obtained from the intravenous administration of large quantities in a short interval of time; that is, from 15 to 30 gm. of protein in from three to five minutes.

Nutritional emergencies also call for the use of plasma protein administered intravenously. Patients who are unable to take food by mouth, such as those who have undergone gastrointestinal operations, can be given glucose, electrolytes, and vitamins along with the plasma protein, which makes for a more balanced parenteral food intake.

Edema in the surgical patient may be due to low plasma-protein levels, with or without an excessive intake of sodium. Two points must be kept in mind in these cases: (1) the sodium intake should be limited because all edemas seem to be associated with sodium retention, and (2) the plasma proteins should be given in concentrated form to increase the plasma volume and encourage the renal plasma flow.

Dehydration is a loss of fluid from the body. On these premises it is advisable to administer plasma proteins to dehydrated patients. Early in the treatment diluted plasma can be given intravenously, but later, as the hydration proceeds, concentrated plasma offers a means of increasing the renal plasma flow and encouraging the re-establishment of water and electrolyte balance by the kidneys.

J. Daniel Willems, M.D.

**Elman, R., Sachar, L. A., Horwitz, A., and Wolff, H.: Regeneration of Serum Albumin with Hydrolyzed Protein in Chronic Hypoproteinemia Produced by Diet. An Experimental Study.** *Arch. Surg.*, 1942, 44: 1064.

Dogs were used in these experiments. The object was to study the regeneration of serum albumin with hydrolyzed protein. On a basal diet consisting entirely of water, electrolytes, sucrose, and Vitamin B complex concentrate, with practically no nitrogen, a progressive fall in the albumin fraction of the blood was produced. The serum globulin remained unchanged. The total fall during the first three weeks amounted to about 30 per cent of the initial value. During the fourth and fifth weeks the albumin continued to fall, but to a lesser degree. Intravenous administration to these protein-depleted dogs of 4 gm. per kilogram of body weight per day of hydrolyzed protein led to a positive nitrogen balance and an increase in the serum albumin to an average of 18.7 per cent above the depletion level. The same rise was produced when the protein hydrolysate was given by mouth. Thus there was no significant difference in the proportion of nitrogen retained or in the amount of serum albumin regenerated, whether the hydrolysate was given by mouth or intravenously.

From their study of the data, Elman and his associates conclude that 96.5 per cent of the nitrogen retained by the animals during the week of therapy with protein hydrolysate is utilized for the replenishment of the tissue proteins, while only about 3.5 per cent can be accounted for in the replenishment of serum albumin. From the therapeutic standpoint, the large doses of protein hydrolysate (4 gm. per kgm.) needed to achieve a rise in the serum albumin of 0.4 gm. per 100 cc. were disappointing, and the authors believe that for this reason the difficulties often experienced in correcting severe degrees of nutri-

tional hypoproteinemia have been due to the fact that insufficient amounts of protein were used.

EDWIN J. PULASKI, M.D.

**Davis, H. A., and Getzoff, P. L.: Hypoproteinemia in Surgical Diseases. Relation of the Serum Protein Level to Hepatic Function and the Influence of the Transfusion of Ascitic Fluid.** *Arch. Surg.*, 1942, 44: 1071.

Hypoproteinemia has been gaining considerable attention from surgeons because of its direct bearing on the favorable outcome of operation. In this article the authors present a new classification of the condition, examine the causative factors, and describe the results of the transfusion of ascitic fluid in a group of patients.

The central site of the formation of plasma proteins is the liver. This is positive with regard to fibrinogen, and probable with regard to albumin. The globulins, however, are probably produced by many tissues, although most of them are formed in the liver.

The liver also serves as a storehouse for the plasma proteins and for their precursors.

With these facts in mind the authors classify hypoproteinemia into 3 types: (1) prehepatic; (2) hepatic; and (3) posthepatic. Hypoproteinemia of the prehepatic type is caused by an interference with adequate intake, digestion, or absorption of plasma protein-building materials. The ability of the liver to form protein is not affected, but the supply of material is not at hand. In the hepatic type the liver itself is incapable of forming proteins in the presence of an abundance of material. In the posthepatic type there is an unusual source of loss which is greater than the replacement power of the liver.

The causative factors in the production of the first type of hypoproteinemia are varied. They include starvation, as, for example, in nutritional or famine edema; inadequate intake of food, due to stricture of the esophagus or to the pain attendant on gastric ulcer or carcinoma; vomiting from pyloric stenosis; inadequate digestion of protein due to previous gastrectomy; inadequate digestion of protein because of achlorhydria associated with diffuse toxic goiter or pernicious anemia; deficient intake of food in the anorexia of the aged; inadequate absorption of food from the intestine because of diarrhea, jejunostomy, ileostomy, or cecal fistula; tuberculous enteritis; regional enteritis; or jejunocolic fistula. Painful defecation may also lead a patient to restrict his food intake with resultant hypoproteinemia. A poorly balanced diet in diabetes may also lead to the condition.

One must not confuse the causation of hypoproteinemia with the causation of the secondary manifestations of that state, such as edema. It is possible to have one without the other. Hypoproteinemia of the prehepatic type seems to be due definitely to an inadequate supply of protein-building materials, since the administration of a high protein diet will abolish the condition. It will not, however, always cause a disappearance of the edema. Other factors enter into the production of edema. In diabetes mellitus associated with hypoproteinemia, edema will occur only in the absence of acidosis.

The association of hypoproteinemia and edema with intrinsic disease of the liver is well established. It has been noted with advanced tuberculous disease of the liver, subacute yellow atrophy, syphilis, portal cirrhosis, and idiopathic atrophy of the liver. However, edema without hypoproteinemia has been seen in acute yellow atrophy and in catarrhal jaundice. The diminution of liver function may explain in part the hypoproteinemia and edema seen in patients with diffuse toxic goiter. An extrahepatic abscess will inhibit protein formation in the liver; in addition there is the important factor of loss of protein into the site of the abscess.

The posthepatic type of hypoproteinemia results from the loss of fully formed plasma proteins. This may be produced experimentally by plasmapheresis, hemorrhage, subcutaneous or intraperitoneal injections of bile, burns, trauma, and freezing. Clinically, it may be seen in cases with protracted loss of blood, helminthic anemia, loss of plasma protein into localized areas due to burns or trauma, and in infections associated with suppuration. The amount of protein that is lost in pus has been estimated at from 8.1 to 21 gm. per 100 c.c. This would explain the occurrence of hypoproteinemia and edema in appendical abscess, peritonitis, infected burns, empyema, and suppurating lung cysts. It should be remembered also that infections with suppuration have an inhibiting influence on the formation of proteins by the liver.

The physiological and pathological effects of hypoproteinemia are readily understood when the function of the serum protein is remembered. It serves 3 main functions: (1) maintenance of the osmotic pressure of the blood; (2) maintenance of the hydrogen-ion concentration of the blood at normal levels; and (3) provision of food material in times of stress.

The interchange of fluid between the tissues and the blood depends on the balance between the hydrostatic and osmotic pressure of the blood stream. When the osmotic pressure is low because of a lowering of plasma proteins, the flow is from the blood stream to the tissues, and edema results. The critical level of proteins below which edema will occur has been found to be 5.5 gm. per cent for total proteins and 2.5 gm. per cent for albumin. Because of its smaller molecule, albumin exerts much more pressure than globulin.

The most obvious changes in tissue structure in hypoproteinemia are, therefore, those produced by edema. There does not seem to be a correlation between the presence of subcutaneous edema and edema of the viscera. One may be absent while the other is present. Other factors are important in determining the time of onset and the distribution of the edema. These are: (1) the amount of fluid intake; (2) the amount of basic ions, particularly sodium ions, present in the body fluids (an increase

in such ions tends to promote edema); and (3) the occurrence of increased permeability of the capillaries.

The tendency to edema formation seems to vary in different tissues. Thus, in conditions producing acute hypoproteinemia with little tissue protein deficit, there is a greater tendency for the formation of ascites and pleural and pericardial effusions than of subcutaneous edema.

Frequently a secondary anemia accompanies hypoproteinemia, but probably the same causative factors underlie both conditions.

Cardiac function does not appear to be affected since the electrocardiogram exhibits no characteristic changes.

Hypoproteinemia affects the motor activity of the gastrointestinal tract, probably by permitting edema of the walls of the stomach and intestines. Diminution in peristalsis and delay in emptying time have been noted.

The relation of liver function to hypoproteinemia is of great interest. In all of their cases the authors noted a diminution of function as measured by the intravenous hippuric-acid test. The other liver function tests, such as the galactose or the levulose tests, showed no changes.

Because of the prerenal deviation of water there is a fall in the urinary output. There is, however, no true renal deficiency.

It is well known that the rate and degree of growth of fibroblasts in wounds are increased by a high protein diet. As is to be expected, therefore, there is a tendency to wound disruption in patients with hypoproteinemia. Wound healing is slow and the tensile strength of the wound is low.

The clinical picture of patients with hypoproteinemia is subject to puzzling variations. Usually such a patient may be classified in 1 of 3 groups: (1) those with cryptic hypoproteinemia; (2) those with hypoproteinemia without edema; and (3) those having hypoproteinemia with edema.

In the first group the condition is masked by an accompanying dehydration. The administration of fluids, particularly by the intravenous route, is promptly followed by the appearance of edema. This group is composed of patients with diseases which interfere with the intake or absorption of water as well as proteins, such as stricture of the esophagus, pyloric obstruction, severe diarrhea, or intestinal fistula.

Hypoproteinemia in patients of the second group is not accompanied by edema of the subcutaneous tissues and is difficult to recognize. It is suspected only when a delay in wound healing or an altered motility of the gastrointestinal tract is noted. Edema of the stoma of a gastroenterostomy may lead to obstructive symptoms.

In patients of the third group, recognition of the condition is simple because of the edema; also other factors are generally associated, such as tissue protein defects due to malnutrition, excessive fluid and salt intake, or sepsis.

The response of hypoproteinemia to therapy depends on the type. The coexistence of a depleted reserve of plasma protein-building material, as in the prehepatic type, or severe liver damage, as in the hepatic type, renders the condition less responsive to treatment. The posthepatic type usually responds rapidly.

Since the function of the liver is lowered in all types of hypoproteinemia, a diet designed to protect the liver should be given. A high carbohydrate, high protein, low fat diet and the intravenous administration of glucose will be found useful.

The presence of infection is a serious barrier to the treatment of hypoproteinemia and edema. Infection not only reduces the function of the liver, but tends to the formation of edema by lowering the permeability of the capillaries. Transfusion of whole blood should be done. This combats the infection as well as the hypoproteinemia. Localized collections of pus should be drained.

The condition may also be associated with a deficiency of Vitamins B and C. These should be supplied. When they are supplied response to treatment is often more rapid.

A paradoxical problem from the viewpoint of therapy is presented by the concurrence of edema and dehydration in patients with hypoproteinemia. In such cases treatment should be directed to the hypoproteinemia. A transfusion of plasma, serum, or ascitic fluid raises the osmotic pressure and fluid is withdrawn from the edematous areas and distributed more equally to other body tissues.

In most cases proteins must be given parenterally as an adjunct to the diet prescribed. The forms available for parenteral use are: (1) whole blood; (2) blood plasma; (3) blood serum; (4) ascitic fluid; and (5) digests of casein.

Ascitic fluid has been proved to be very good. It may be given either subcutaneously or intravenously, and no preliminary typing or cross matching is necessary.

The authors present several interesting tables.

ROBERT D. MANSFIELD, M.D.

## ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

**Bowen, F. H.: Report of 661 Nail Puncture Wounds of the Foot.** *J. Am. M. Ass.*, 1942, 119: 413.

The author demonstrated that nails coated with gentian violet and driven into a cadaver's foot are wiped clean in the proximal ¼ in. of the tract. Also, in attempting to follow a tract made by a nail in the foot that was moved to simulate walking, it was found that because of the over-riding layers of fascia the tract could not be followed.

In practice, it was found that by doing a superficial débridement, particles of sand were just beneath the epidermis and, occasionally, rust particles and little pieces of concrete or rubber were found in the same location. To probe a wound one injures tissue not traversed by the nail and opens new tissue

planes to infection. The introduction of a drain into a noninfected wound tends to convert it into an infected wound. The following mode of treatment was employed in the care of 661 nail puncture wounds of the foot:

The foot was soaked for from fifteen to thirty minutes in hot water to which liniment of soft soap or a small quantity of saponated solution of cresol was added, and dried carefully; then an area of about 2 or 3 in. in diameter was painted around the wound with an antiseptic. The wound edges were grasped with splinter forceps and the epidermis was cut away for several millimeters about the circumference of the wound. This exposed the foreign matter (usually sand, rarely particles of sock, leather, rust, rubber, or concrete), which could then easily be removed with the splinter forceps, or be wiped away with a cotton applicator soaked in an antiseptic. The wound was not probed beyond ¼ in., and this was done under direct vision. A dry dressing was applied and 1,500 units of tetanus antitoxin were given. If the wound was caused by a nail larger than a 10-penny, the patient was instructed not to work for at least one or two days, but if a nail of lesser diameter was involved he returned at once to work. The patient was instructed to soak his foot in hot water for thirty minutes when he reached home and to repeat this at bedtime.

Patients with severe nail wounds, caused by a nail larger than a 10-penny, or lacerated wounds, were given crutches and told not to bear weight on the affected foot for one or two days. They were told to report to the hospital on the day they returned to work for inspection of the wound. If any sign of increasing inflammation was present, elevation and rest of the affected limb with hot compresses was advised. Patients with minor wounds were instructed to return if any increased soreness was noted. No prophylactic sulfonamide treatment was used locally or orally. Only patients who came for treatment on the day of the injury are considered in this group of 661 cases. There were no deaths in this series. There was no tetanus encountered in this series, or in any of the 1,000 nail wounds treated. There were four hundred days of disability, a disability per case of 0.6 of a day. Cases of disability due to tetanus antitoxin have not been considered in this series. MANUEL E. LICHTENSTEIN, M.D.

## SURGICAL INSTRUMENTS AND APPARATUS

**Maxwell, R., and Savage, F. I. C.: The Sterilization of Paraffin Surgical Dressings.** *Brit. M. J.*, 1942, 1: 472.

The author discusses 2 recommended methods for sterilization of dressings impregnated with greasy material. Methods for testing the sterilization of these dressings are described.

The water-bath method for sterilization of vaseline gauze or soft paraffin dressings is shown to be ineffective. Tulle gras can be effectively sterilized if an autoclave is used, if enough balsam of Peru is present, and if the cotton contains the normal amount of moisture. EDWARD W. GIBBS, M.D.

# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

**Reitan, H.: On Movements of Fluid Inside of the Cerebrospinal Space.** *Acta radiol.*, Stockh., 1941, 22: 762.

On fluoroscopic examination during myelography the author noted respiratory movements of the iodized-oil column within the dura. The upper level of the column was raised during inspiration and depressed on expiration, both when the patient was erect and when his head was only slightly raised. The elevation of the iodized-oil column was accompanied by a simultaneous concentric narrowing of the dural tube. When the abdominal pressure was raised, the excursion of the column was greater.

These findings are of great practical significance. The filling defect produced in the iodized-oil column by small laterally placed protruded discs or thickened ligamenta flava might be reduced or caused to disappear completely on inspiration, when the dura is forced away from the walls of the vertebral canal by the pressure of the surrounding venous plexus. The narrowing of the dural tube may explain the aggravation of sciatica pain by defecation, coughing, or sneezing. This movement of the spinal fluid is of particular importance in spinal anesthesia. Upon increase of the abdominal pressure, the anesthetic introduced into the dural tube may be forced to a higher level than had been intended.

HAROLD C. OCHSNER, M.D.

**Erikson, S.: The Roentgen Diagnosis of Meningioma of the Olfactory Nerve** (Die Roentgendiagnostik des Olfaktorius-Meningeoms). *Acta radiol.*, Stockh., 1941, 22: 581.

The Roentgen Department of the Serafimer Hospital in Stockholm examined 14 patients with meningioma of the olfactory nerve from 1935 to 1940, who later were operated on by Olivecrona. They were studied by Lysholm's technique of ventriculography. Anteroposterior, transverse, and axial exposures, occasionally also special studies of the ethmoid area, were used. Abstracts of the findings on films, ventriculography, and operation of these 14 cases are given.

Fig. 1.

Fig. 2.

While these tumors usually produce increased intracranial pressure, they occur at an age when the sutures between the bones of the calvarium are too firm to permit diastasis. No such diastasis nor increase of the digitate impressions was found in these patients.

Increased intracranial pressure may lead to atrophy of the base of the skull with destruction of the dorsum sellae. This was found in 5 of the author's cases, but he attributes it to directly conducted pressure from the large tumor rather than to intraventricular increase of pressure. In cases in which there is calcification of the corpus pineale, important conclusions can be drawn from displacement of this shadow. In 5 of 9 cases in which calcification was present, it was found that there was dorsad and craniad displacement of the corpus pineale.

In 5 cases exostoses of the neighboring bones were found, constantly in the posterior part of the lamina cribrosa, in the midline. They appear as well defined rounded flat bone hills, with sclerotic bone (Figs. 1 and 2) distinct both in sagittal and frontal exposures, and of varying size. The alae minores ossis sphenoidalis, and the crista galli and the nasofrontal suture interfere with conclusive interpretation of these changes. Pressure atrophy of the bone in the anterior fossa may occur, but was not found in the cases reported, neither were any intratumoral calcifications (once shown by Cushing), observed.

The diagnosis of a meningioma of the olfactory nerve by means of films of the skull depends on the presence and demonstration of exostoses.

As most of these tumors grow chiefly symmetrically (only 1 of the author's cases showed unilateral development), typical changes can be demonstrated upon ventriculography: the tumor displaces the anterior horns of both lateral ventricles toward the vertex and the occiput, the amount of displacement depending on the tumor's size. Asymmetrical development leads to asymmetrical displacement. There may be a typical concave filling defect in the anteroinferior contour of the anterior part of the anterior horns. In larger tumors, the anterior horns appear to be pushed apart.

Differentiation of these changes from those produced by other expansive processes in the anterior fossa is necessary. Parasagittal tumors of the upper part of the frontal bone displace the ventricles toward the occiput, but also toward the base of the skull. As Olivecrona has pointed out, gliomas arising in the medial part of the frontal lobe may create ventriculograms indistinguishable from those found in meningioma of the olfactory nerve. However, the indentation of the lower contour of the anterior horn is not as smooth as that found in extracerebral tumors.

HEINRICH LAMM, M.D.

**Klason, T.: On Perforated Gastroduodenal Ulcers. Roentgen Examination and Clinic.** *Acta radiol.*, Stockh., 1941, 22: 687.

Ninety-seven cases of surgically proved perforated gastroduodenal ulcer were studied. In this series the mortality rate was 16.4 per cent.

Since early operation is imperative, the information obtained by roentgen examination is of great importance.

In a patient who is acutely ill, the presence of an abnormally great distance between the stomach and duodenum and the lower surface of the liver is of great importance. Evidence of air free in the peritoneal cavity at the onset of acute indigestion indicates perforation; it was found in 9.17 per cent of the author's cases. Air is best demonstrated by a film taken in the left lateral decubitus position with the ray projected horizontally. In this position the air accumulates between the liver and the diaphragm. Occasionally, when only a minute amount of air is present, it is present in the form of a small bubble in the corner between the inner wall of the abdomen and the edge of the right lobe of the liver.

The stomach which is perforated in usually more or less gasfilled. If perforation is suspected and no free air can be detected, while the stomach is empty and contracted, it is probable that no perforation is present.

Perforation occurs most frequently in the morning, in the afternoon, and at midnight. It usually occurs two or three hours after a meal. Trauma is of little importance in the production of perforation.

HAROLD C. OCHSNER, M.D.

**Frimann-Dahl, J.: Roentgen Findings in Intestinal Knots.** *Acta radiol.*, Stockh., 1942, 23: 22.

Although intestinal knots have been given adequate consideration in medical literature from the clinical point of view, their roentgenological aspects have been neglected. Two cases have come under the author's observation, which offered good opportunity for roentgen study, and they form the basis of this report. The condition is reviewed in relation to etiology, pathogenesis, and clinical manifestations, and attention is called to the fact that the diagnosis is usually uncertain, therefore added information which might lead to its recognition is highly desirable.

The 2 cases observed are reported in detail. In both of them roentgen studies were made about three hours after the onset of the illness. Both showed a gas-distended loop of large bowel on the right side, which was interpreted as being the sigmoid, and several gas-distended massed loops of small bowel were seen on the left side. Fluid levels were noted in the upright position. In the first case an opaque enema was obstructed in the sigmoid with a conical tapering of fine bands suggesting a twisted relief. A diagnosis of an atypical form of sigmoid volvulus was ventured. The second case did not receive an opaque enema. The roentgen diagnosis of it was mechanical ileus possibly due to mesenteric torsion. The diagnosis of intestinal knots was made at operation in the first case and at autopsy in the second.

In his discussion, the author calls attention to the fact that the absence of visible gas in parts of the large intestine other than the distended sigmoid is of value in differentiating the condition from genuine volvulus. The spigot-shaped off-shoot of the sigmoid seen on the scout film is also considered a special roentgen finding in knot formation. With the opaque enema, a trunk-shaped off-shoot of the enema shadow at the obstruction apparent on lateral view is also believed to be distinctive. Lateral views are of value also in showing the relative positions of the distended loops of intestines and in demonstrating a narrowing with a typical curved trunk shape toward the site of the knot. Some points of differentiation from stenosing ileus, mesenteric strangulation, and mesenteric thrombosis are also given consideration.

A. HARTUNG, M.D.

**Nielsen, J., and Jensen, S. H.: Some Experimental and Clinical Lights on Rotation Therapy, Its Basis and Possibilities.** *Acta radiol.*, Stockh., 1942, 23: 51.

Rotary irradiation either by moving the tube partly or all the way around the patient, or by rotating the patient about an axis through the tumor while the tube remained stationary has been suggested and practiced by a number of radiologists, and within recent years has been the object of increasing interest as a comparatively simple, practical means of improving the therapeutic depth dose. This method may be regarded as consisting in the employment of many small fields which are irradiated in succession, each with a fraction of the full dose. The amount of radiation received by the skin is exceedingly low, while the centering of these many fields in the tumor must result in the latter receiving a large dose. In order to investigate these matters more closely the authors have made a number of measurements, partly on anatomical preparations, partly on phantoms. The experiments conducted and the measurements taken are described in detail.

The depth dose for small, stationary fields of less than 50 sq. cm. was measured for different ray qualities. A number of intensity-distribution curves are reproduced, which show that a central zone, forming a cylindrical core about the axis of rotation, receives a homogeneous radiation dose considerably larger than the equally homogeneous dose received by the surrounding, peripheral zone. The fall in intensity, from one zone to the other, is abrupt. The ratio of the maximum dose to the peripheral dose depends on the size of the field (the diaphragm opening), but is only to a slight extent dependent on the ray quality (within from 0.35 to 1.75 mm. of copper H. V. L.) and the focus-axis distance.

The authors relate their clinical experience with rotation treatment in 8 cases of cancer of the esophagus. The arrangement used was very simple. The patient sat on a motor-driven, rotating seat, the

rate of rotation of which could be varied from ten to thirty minutes for a complete rotation. By means of an adjustable lead diaphragm placed at a distance of about 20 cm. from the focus of the tube, a small beam, from 2 to 3 cm. broad and from 3 to 5 cm. high, was cut off. The patient was placed in the stool in such a manner that the esophagus lay in the axis of the stool's rotation. This was controlled by screening, after the patient has been made to swallow a small mouthful of thick barium porridge. During the rotation, the centering was controlled by continued screening during the whole time of exposure, the therapeutic radiation being used directly for the purpose.

Because of the small size of the fields made possible by the constant screening control, the general condition of the patients was very little affected. Daily doses of 2 x 1,000 roentgens were tolerated without difficulty. Even with a total dose of 22,000 roentgens in the course of four weeks, only a moderate erythema was observed on the skin. In the cases treated, the primary effect on the tumor was good, and the stenosis was overcome.

The possibility of applying the rotation therapy to other tumors (cancers of the uterus, rectum, and hypophysis) is discussed, and the value of the screening control emphasized. A. HARTUNG, M.D.

**Ellis, F.: Volume Dosage in Deep X-Ray Therapy.** *Brit. J. Radiol.*, 1942, 15: 174.

The volume dose of radiation is the total amount of energy absorbed by the patient. Since the effects on the general system from too much x-ray treatment are profound, it is important clinically that the volume dosage be estimated accurately.

The author already in 1936 started to use the "roentgen cubic centimeter" as the unit of volume dose and since then, with the collaboration of Happey, prepared x-ray dosage charts embodying also for each beam used the constitutional dose in "r. cc.". However, soon it was found that account must be taken also of the radiation scattered outside of the geometrically defined beam. While these investigations were in progress, Mayneord was engaged independently in the same problem but along somewhat different lines.

To enable the clinician to calculate total energy absorption without further aid from the physicist, the graph in Fig. 1 is utilized. The volume dose then is the product of the following factors:

$$D \times A \times \text{graph reading} \times \frac{(100 \text{ max. per cent back scatter})}{(100 \text{ per cent back scatter for field used})} = \text{total}$$

energy absorption in r. cc./or ergs, when D is the surface dose in roentgens measured with back scatter and A is the area in square centimeters of the field used. The graph reading is made for the thickness of tissue of every field. The maximum skin dosage rate in r/min. is divided by the skin dosage rate for the field size used. The result is expressed in roentgen cubic centimeters, or in ergs. Mayneord uses the unit of 1 megagram roentgen, which corresponds to $10^6$ r. cc.

Certain reservations, however, must be made. The graph in Fig. 1 applies to any x-ray beam of 1.5 mm. Cu. H.V.L., but for other situations different graphs may be secured from the author, c/o Sheffield Radium Center. Then minor corrections must be made in connection with the skin dosage rate if the fields are very small and in connection with the area of field, if the focal skin distance is very short, or the field very large.

A good example of the value of the volume dosage estimation is represented by the old and new method of the author in treating carcinoma of the lung. Whereas formerly he used large fields including the opaque lung shadow in its entirety, he now employs multiple small fields, crossfiring only the region of the obstruction in the bronchus after accurate localization, unless the carcinoma has spread further.

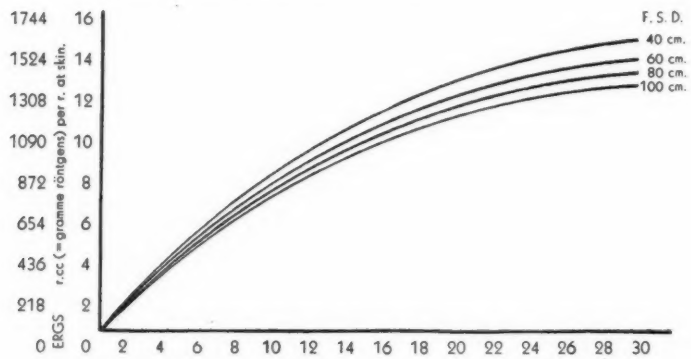


Fig. 1. Graph relating volume dose per roentgen at skin surface to thickness of tissue through which the beam passes. (Thickness of tissue in centimeters.)

TABLE I.—TECHNIQUE AND TOTAL ABSORPTION OR VOLUME DOSE

H.V.L. = 1.5 mm. Cu. F.S.D. = 40 cm.

| Region | Dose 1000 r | Fields No. cm.² | Total absorption r.cc. |
|---|---|---|---|
| Tonsil | 4.5 | 2 by 10/8 | $7.77 \times 10^6$ |
| | | 2 by 6/4 | — |
| Fauces | 4.0 | 2 by 10/15 | $11.26 \times 10^6$ |
| | | 2 by 6/4 | — |
| Larynx | 5.0 | 2 by 6/8 | — |
| | | 1 by 6/4 | $4.53 \times 10^6$ |
| Brain | 4.0 | 2 by 10/8 | — |
| | | 1 by 6/8 | $11.97 \times 10^6$ |
| Bladder | 5.6 | 8 by 8/0 | $17.24 \times 10^6$ |
| Pelvis (Supplement to radium) | 3.0 | 2 by 20/15 | $25.97 \times 10^6$ |
| | 3.0 | 2 by 20/15 | — |
| Esophagus | 6.0 | 8 by 15/4 | $31.1 \times 10^6$ |
| Lung | 4.0 | 4 by 10/15 | $30.3 \times 10^6$ |
| Lung | 5.5 | 5 by 6/8 | $19 \times 10^6$ |

1. Old method. Four fields of 10 by 15 cm., 200 kv., 1 mm. of copper, 10 ma., 40 cm. std. Maximum skin dosage rate = 92 r/min. Skin dosage rate for field used = 86.6 r/min. Skin dose = 3420 roentgens; tumor dose = 4000 roentgens.

| Tissue thickness Cm. | Graph reading e.s.u. = r.cc. |
|---|---|
| 18 | 12.80 |
| 18 | 12.80 |
| 28 | 15.02 |
| 28 | 15.02 |
| | 55.64 |

Volume dose $= 3420 \times 150 \times 55.64 \times \frac{92}{86.6} = 3.03 \times 10^7$ r. cc. = 30.3 megagram roentgens $= 3.3 \times 10^9$ ergs.

2. New method. Five fields of 6 by 8 cm., 200 kv., 1 mm. of copper, 10 ma., 40 cm. std. Maximum skin dosage rate = 92 r/min. Skin dosage rate = 76 r/min. Skin dose = 4680 roentgens; tumor dose = 5500 roentgens.

| Tissue thickness Cm. | Graph reading e.s.u. = r.cc. |
|---|---|
| 19 | 13.14 |
| 19 | 13.14 |
| 27 | 14.90 |
| 28 | 15.02 |
| 25 | 14.50 |
| | 70.70 |

Volume dose $= 4680 \times 48 \times 70.70 \times \frac{92}{76} = 1.9 \times 10^7$ r. cc. = 19 megagram roentgens $= 2.07 \times 10^9$ ergs.

Other examples taken from cases treated routinely at the Sheffield Radium Center are given in Table 1.

TABLE II.—EFFECT ON VOLUME DOSE OF INCREASED F.S.D.

(Carcinoma of Esophagus, 40 cm. F.S.D. and 100 cm. F.S.D.)

| 200 kV 1.5 mm. Cu H.V.L. Field Size 15 by 4 cm.² | | Tumor dose = 6000 r Eight Fields | |
|---|---|---|---|
| F.S.D. = 40 cm. Field Dose = 3400 r | | F.S.D. = 100 cm. Field Dose = 2800 r | |
| r.cc./cm.²/r | Field | Thickness | r.cc./cm.²/r |
| 13.4 | 1 | 19 cm. | 11.79 |
| 13.4 | 2 | 19 cm. | 11.79 |
| 13.82 | 3 | 22 cm. | 12.47 |
| 13.82 | 4 | 22 cm. | 12.47 |
| 13.82 | 5 | 22 cm. | 12.47 |
| 13.82 | 6 | 22 cm. | 12.47 |
| 15.3 | 7 | 30 cm. | 13.6 |
| 15.3 | 8 | 30 cm. | 13.6 |
| 112.68 | | | 100.66 |
| Total energy absorption | | | |
| $3400 \times 60 \times 126 \times \frac{92}{76.3}$ r.cc. | | $2800 \times 60 \times 101 \times \frac{92}{76.3}$ r.cc. | |
| $= 3.11 \times 10^7$ r.cc. (125 per cent) | | $= 2.48 \times 10^7$ r.cc. (100 per cent) | |

The influence of variation of the focal skin distance on the volume dose is indicated in Table II.

T. LEUCUTIA, M.D.

**Bisgard, J. D., Hunt, H. B., Neely, O. A., and Scott, P.: The Mechanism of Action of Roentgenotherapy upon Infection.** *Ann. Surg.*, 1942, 115: 996.

In the course of some rabbit experiments to determine the effect of the sulfonamide drugs and of roentgenotherapy upon peritoneal infections produced by several different micro-organisms, acting both alone and in combination, the authors obtained information which they believe may throw some light on the mechanism of roentgenotherapy upon infection. The experiments are described in detail and the inferences drawn are discussed at length.

It was found that irradiation lowered the mortality from toxemia. The peritoneal fluid was always increased in quantity within a few hours after irradiation. When this fluid was aspirated and mixed *in vitro* with a lethal dose of either the killed or live culture the toxins were sufficiently affected in each instance to render them incapable of killing the animals. Peritoneal washings from nonirradiated rabbits did not exert this influence. Since the same effect was obtained from an admixture of the live and the killed culture and serum from animals irradiated forty-eight hours previously, it was apparent that whatever the product resulting from irradiation, it was present in the blood stream and thus generally disseminated.

In explanation of these observations, the following theory is offered as a mere suggestion. Roentgen-ray irradiation caused injury to the tissue cells. In response to this insult the cells, or some group of cells, liberated a protective or antitoxic factor. This factor was present twenty-four hours after irradiation and probably sooner, but it apparently developed too slowly to be of benefit to the rabbits which received irradiation after they were inoculated. It reached its peak of effectiveness in forty-eight hours, and by the seventh day it apparently had been entirely dissipated. A. HARTUNG, M.D.

**Higinbotham, N. L., and Coley, B. L.: Methods and Effects of Preoperative Irradiation in the Treatment of Osteogenic Sarcoma.** *Am. J. Roentg.*, 1942, 47: 902.

In the treatment of osteogenic sarcoma, at least 4,000 roentgens must be delivered to all parts of the tumor to destroy it. Irradiation alone gives the least satisfactory five-year survival rate of 8.5 per cent; surgery alone gives a 31 per cent rate, while the combination of preoperative irriadiation and radical surgery gives the more encouraging five-year survival rate of 34 per cent.

After a careful history, a complete physical examination, serologic and blood chemistry determinations, and roentgenographic examination of the region of the tumor, as well as of the chest for possible metastasis, a tentative diagnosis is made on the combined findings. Microscopic confirmation is obtained by aspiration biopsy and, if necessary, by formal operative biopsy.

The extent of the lesion determines whether treatment must be given at one or two levels. If the tumor extends a considerable distance up the shaft of the bone, an upper and a lower level may be required to cover adequately the diseased area. The circumference of the involved extremity determines whether two portals, or three, or four may be utilized. The authors employ from 200 to 400 roentgens daily to one portal or, if two levels are used, two portals may be treated each day. The total tumor dosage must be at least 4,000 roentgens. In most cases roentgen rays generated at 200 kv. were used.

During or following irradiation, partial or complete relief of pain is noted in practically all cases. The permanence of the relief of pain is a fairly reliable indicator of the degree of control of the pain. Disability may diminish in proportion to the relief of pain effected, and to obviate pathological fracture, adequate support must be supplied. The skin effect is a distinct erythema with slight vesiculation.

Adequate amounts of radiation cause an appreciable drop in the serum phosphatase through partial or complete inactivation of the phosphatase-producing mechanism. When amputation follows the irradiation cycle, there is a further drop in the serum phosphatase to normal levels.

Irradiation alone should not be relied upon in the treatment of osteogenic sarcoma. The ideal treatment of sarcomas that are radiosensitive is carefully planned preoperative radiation therapy followed by amputation. The tumors in adults are apt to be more radioresistant, and in most of these cases early amputation is recommended without preoperative irradiation. In inoperable cases irradiation alone may be given for its palliative effect. Irradiation of the lung fields for pulmonary metastases is of questionable value. HAROLD C. OCHSNER, M.D.

**Horrax, G., and Daniels, J. T.: The Conservative Treatment of Pineal Tumors.** *Surg. Clin. N. America*, 1942, 22: 649.

In view of the fact that many pinealomas are highly radiosensitive, conservative treatment of them with radiation is preferable to surgical extirpation, which is rarely successful. This conservative treatment consists in a subtemporal decompression followed by one or more courses of roentgen therapy. Definite diagnosis of the presence of this tumor is absolutely essential to avoid giving this treatment to patients who may have similar symptoms with lesions giving a more favorable operative prognosis. Ventriculography is considered necessary as a final diagnostic measure even in the presence of fairly characteristic localizing neurological signs. It presents dilated lateral ventricles, dilatation of the anterior portion of the third ventricle, and the presence of a rounded shadow in the posterior portion of the third ventricle, which, when other localizing criteria exist, is pathognomonic of a pineal tumor.

In a previous communication, 2 cases having received combined roentgen and operative treatment were reported. These are cited briefly and the results in them to date given.

The purpose of the present communication is to report upon 3 further cases of almost certain, but as yet histologically unverified cases of pineal tumor, all of which have responded remarkably to the conservative treatment of subtemporal decompression and x-ray therapy, and a fourth case in which decompression was omitted because symptoms of increased intracranial pressure were lacking. Even so, the omission of the decompression was probably a mistake in this patient, since certain difficulties supervened during the course of his treatment. Comments relative to the diagnosis and results in the individual cases are included. All 4 patients have been returned to useful life for periods of from one and one-half to two and one-half years, with their previous symptoms almost entirely relieved.

A. HARTUNG, M.D.

## RADIUM

**Ahlbom, H. E.: The Results of Irradiation Treatment of Endolaryngeal Carcinomas at the Radiumhemmet, Stockholm, from 1930 to 1939** (Die Resultate der Strahlenbehandlung von endolaryngealen Karzinomen am Radiumhemmet, Stockholm, von 1930 bis 1939). *Acta radiol.*, Stockh., 1941, 22: 539.

Ahlbom limits his report to the truly endolaryngeal tumors. In accordance with his laryngological

collaborators he divides them into the following groups of cases.

Group 1 comprises cases in which the vocal cords still are completely motile and in which the carcinoma involves only one vocal cord, reaching neither the anterior commissure nor the vocal process.

Group 2 comprises cases in which the motility of the vocal cords is still preserved, but one cord is fully involved and the anterior part of the opposite cord is also carcinomatous.

Group 3 comprises cases of more extended unilateral laryngeal carcinomas which, however, have reached neither the anterior commissure nor the introitus laryngis, nor have infiltrated the arytenoid area extensively.

Group 4 includes the cases with extended endolaryngeal involvement, unilateral or bilateral and with or without regional lymph metastases.

In the cases of Group 1, endolaryngeal surgery or with laryngofissure, according to the involvement, and irradiation treatment seem to produce about equally good results.

The cases of Group 2 should be treated radiologically only, as surgery may result in functional disturbance. Their prognosis is favorable with either approach.

The patients belonging to Groups 3 and 4 usually were treated by laryngectomy followed by irradiation, except those who refused surgery or whose general or local condition forbade it. In the latter cases only radiotherapy was given.

The irradiation treatment consisted of teleradium therapy in postoperative and nonsurgical early cases, especially of cases in Groups 1 and 2, and in cases of Groups 3 and 4 with relatively limited involvement and lymph metastases. The remaining patients received roentgen treatment, sometimes combined with teleradium.

Technical details concerning irradiation technique should be read in the original by those interested. The total dose was usually 6,000 roentgens over a period of twelve to fourteen days. In about 75 per cent of the laryngectomy cases irradiation was used to prevent necrosis in the scar.

Ahlbom reviews the results in 78 patients. Thirteen of these belonged to Groups 1 and 2. Five of them were treated surgically and radiologically, and were symptom-free after ten, five, three, one and one-half years and one year, respectively, with good preservation of the voice. The remaining 8 patients of these groups were treated by teleradium irradiation only and showed good results; 1 of them has been well for seven years, 3 for four years, and 4 for more than two years. Of the 65 patients of Groups 3 and 4, 38 patients were treated by laryngectomy and irradiation. In two-thirds of them five-year cures were obtained. This is an unusually high percentage of success. Ahlbom attributes it to (a) centralization of treatment of laryngeal carcinoma, (b) exact and relatively strict indications for laryngectomy through close collaboration between the laryngologist and radiotherapist, (c) excellent surgical technique, and (d) intensive prophylactic teleradium treatment.

The 27 cases which were treated exclusively with irradiation comprised 20 inoperable and 7 so-called borderline cases. The results in these cases seem to be somewhat better than those obtained in hypopharyngeal carcinomas. HEINRICH LAMM, M.D.

# MISCELLANEOUS

## CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

**Lippmann, A.: On the Insensible Perspiration and Its Clinical Significance.** *Med. J. Australia*, 1942, 1: 569.

The insensible perspiration was measured by means of the Sauter balance, which calls for little if any collaboration with the patient. This method is recommended for clinical purposes because the results are reliable and reproducible. It provides a valuable supplement to, and sometimes an improvement upon, the determination of the basal metabolic rate as a clinical test.

The value of the Benedict and Benedict curve showing the fixed relation between the basal metabolic rate and insensible perspiration was tested. In 80 per cent of all the normal cases the figures for insensible perspiration were within a range of −10 per cent of the predicted values. In the other normal cases the figures were usually from 10 to 20 per cent lower than the predicted values. The figures were unreliable if the basal metabolic rate exceeded 1,800 calories per day or if the insensible perspiration rate was above 40 gm. per hour. The figure for the total water loss per hour (without any correction) was found to be about 19.5 gm. per square meter; the "relative" insensitive perspiration was up to 30 per cent. The control of the skin temperature is indispensable for reliable results in experiments upon insensible perspiration.

The author found that young Australians seem more reactive to slight temperature changes than individuals living in moderate climates. Day-time sleep decreased the insensible perspiration rate by about 15 per cent. Pyramidon had no effect, but erythema produced by ultraviolet irradiation decreased insensible perspiration greatly by means of a local effect. WALTER H. NADLER, M.D.

**Hirsch, J. M., and Quintero Muro, E.: Fractures and Dislocations Occurring During Convulsions Following the Administration of Drugs, and their Prevention.** (El problema de las fracturas y lujaciones en la terapeutica convulsivante y su prevencion). *Bol. hosp.*, Caracas, 1942, No. 2, 68.

Since the introduction of cardiazol, called "metrazol" in the United States, into the treatment of schizophrenia or dementia praecox, numerous cases of fractures or dislocations occurring during convulsions caused by the drug have been reported. These cases are apt to discredit the convulsive shock therapy of chronic depressive psychoses.

Numerous attempts have been made to prevent such traumatic complications, among which are the following: (1) mechanical measures; (2) mechanical measures combined with the administration of drugs; and (3) the use of drugs exclusively. Four drugs are popular for the prevention of fractures complicating convulsive therapy; they are curare, betaerythroidin, quinine metachloride, and magnesium sulfate.

The authors of this article provoked 4,000 convulsive shocks without a single fracture which could be diagnosed clinically. They inject curare intravenously two minutes before the introduction of the cardiazol. The relaxation of the muscles under the influence of the first drug attenuates the effect of the second drug. Because of this prophylactic action of curare the convulsive therapy can be employed even in aged patients or patients with cardiac lesions. The dose of curare employed by the authors ranged from 2.05 to 5 cc., each cubic centimeter containing 20 mgm. of the pure drug.

Impairment of vision, bilateral ptosis, and paresis of the spinal muscles, followed by a paresis of the muscles of the extremities, are common results of the injection of curare and should not alarm the physician. Occasionally, artificial respiration must be instituted and only in 1 case was the author forced to inject prostigmine to counteract the effect of the curare. JOSEPH K. NARAT, M.D.

**Elman, R., Weiner, D. O., and Bradley, E.: Intravenous Injections of Amino Acids (Hydrolyzed Casein) in Postoperative Patients.** *Ann. Surg.*, 1942, 115: 1160.

A mixture of amino acids obtained by the enzymic hydrolysis of purified casein was injected intravenously into 312 patients. The number of injections totaled 1,013.

This mixture of amino acids was prepared by the Barnes Hospital, St. Louis, Missouri, and also by a commercial house. Slightly different methods were employed, but the results were the same. The amino acid mixture is called "amigen." This is a white powder which forms a clear, amber-colored solution with a pH of 4.5. It was used in a representative cross section of both medical and surgical patients at the Barnes Hospital.

Amigen was given in a 2.5 per cent or a 5.0 per cent solution at a rate of from 300 to 500 cc. per hour. At this rate the patient received from 8 to 12 gm. of protein per hour. In a few cases the solution was given much more rapidly without untoward effects. In general, each patient received from 1 to 2 liters of amigen solution per day.

Detailed records of the results were obtained; reactions were closely observed during and after the administration of amigen. Pyrogenic reactions occurred in 15 instances, but in 10 of these the cause was definitely determined to be pyrogenic distilled water; the other 5 instances were of doubtful origin. In 2 instances urticaria followed the administration of amigen, and flushing of the skin occurred occa-

sionally. If the amigen was injected too rapidly abdominal pain, nausea, and vomiting resulted. Phlebitis did not occur when the 2.5 per cent solution was used, but stronger concentrations were neutralized to a pH of 6.5 before use. No fatalities could be attributed to the amigen injections.

Amino acids are utilized when injected intravenously as amigen. This is shown by the fact that nitrogen retention was marked and persisted even during two weeks of therapy, and, in addition, there were significant increases in the plasma-protein concentration. From a clinical point of view, amigen provided beneficial and even dramatic effects.

Protein deficiency is of more common occurrence than has generally been thought. For example, depletion of plasma albumin begins as soon as protein intake is stopped. Other tissues undoubtedly suffer when their protein is depleted. The striking therapeutic effect of plasma in protein-deficiency states is widely known. However, plasma has two drawbacks: (1) the large amount of plasma needed to supply adequate protein, and (2) the replacement of blood proteins only. In contrast, amigen can be given in quantities sufficient to supply 300 gm. of protein a day; moreover, the protein is supplied in a form which can be utilized by all tissues immediately. On the whole, patients receiving amino acids intravenously tolerate the injections well, and give ample evidence of clinical benefit.

LUTHER H. WOLFF, M.D.

**Warkany, J., and Nelson, R. C.: The Experimental Production of Congenital Skeletal Abnormalities in the Offspring of Rats Fed a Deficient Diet.** *Am. J. Roentg.*, 1942, 47: 889.

Congenital malformations can be the result of any factor which interferes with normal intrauterine development without lethal effect on the embryo. One of these may be a deficient diet of the mother, as was demonstrated by certain experiments carried out by the authors.

When 439 female rats were reared and bred on a diet consisting of 76 per cent yellow corn meal, 20 per cent wheat gluten, 3 per cent calcium carbonate c.p., and 1 per cent sodium chloride c.p. (Steenbock and Black's rachitogenic diet), supplemented by 60 I.U. of Vitamin D every tenth day, about one-third of the offspring showed congenital malformations. Of 544 females of the same strain bred on an adequate stock diet, only 1 abnormal offspring resulted and its defects were different from those of the offspring born on the special diet.

Of the defects recognizable by external inspection, shortness of the mandible, protrusion of the tongue, and shortness of the extremities with various types of malformations are mentioned. Skeletal abnormalities were visualized by the method of Schultze and Dawson and included changes in the mandible, ribs, and bones of the extremities, all of which are described in detail. Almost all of the deformed animals were either born dead or died within forty-eight hours after birth. One of them which survived, and which was reared on an adequate diet, showed fusion of the ribs on the roentgenogram in adulthood. The histological findings of the abnormal structures are also given consideration.

The malformations of the offspring could be prevented easily by a change in the diet of the mothers. If 2 per cent pig liver was added to the deficient diet, entirely normal offspring were obtained. When the same pair of animals was bred alternately on the deficient diet and a similar diet which contained liver in addition, abnormal and normal offspring could be obtained alternately. A. HARTUNG, M.D.

**Abels, J. C., Rekers, P. E., Martin, H., and Rhoads, C. P.: The Relationship between Dietary Deficiency and the Occurrence of Papillary Atrophy of the Tongue and Oral Leucoplakia.** *Cancer Research*, 1942, 2: 381.

Three groups of patients having papillary atrophy of the tongue, oral leucoplakia, or both, were observed over a period of one year. The incidence of syphilis, excessive use of tobacco, and dietary deficiency in these groups was compared with that in control groups. Examinations were made for other pathological conditions which might be associated with the oral lesions. Investigations of hepatic function, gastric acidity, plasma levels of Vitamin A, and urinary excretion of riboflavin were carried out in connection with the problem of possible dietary deficiency. The effects of administration of large amounts of yeast on the course of the oral lesions were observed.

The incidence of syphilis in patients with either glossal papillary atrophy or oral leucoplakia was not significantly higher than in the control groups, but the use of tobacco by these patients was found to be abnormally great. Dietary histories obtained from the same patients showed that from 55 to 61 per cent of the individuals with oral lesions had been on inadequate diets for at least three years. These figures were much higher than those representing the incidence of inadequate diet in the control groups. The history of dietary deficiency was in the main confirmed by low plasma values of Vitamin A and urinary output of riboflavin. The evidence also indicated that achlorhydria could condition a dietary deficiency in cases in which the diet had been normal, and aggravate the deficiency state of individuals in whom the diet had been inadequate. Another factor which can condition dietary deficiency is hepatic insufficiency. A significant number of patients with oral lesions were found to have hepatic dysfunction. Taking the 3 factors of inadequate diet, achlorhydria, and hepatic dysfunction into consideration as causes of deficiency states, 82 per cent of patients with papillary atrophy of the tongue, 65 per cent of patients with oral leucoplakia, and 81 per cent of those with combined lesions were suffering from dietary deficiency.

The symptoms associated with oral lesions were soreness of the mouth or tongue, dysphagia, epigastric pain, constipation, and weight loss. Because of

the frequency of gastrointestinal symptoms elsewhere than in the mouth, it is conceivable that coincidental lesions might exist along the digestive tract which are related to papillary atrophy and leucoplakia. Functional and organic changes of the gastrointestinal tract were frequently found by x-ray and gastroscopic study. Such abnormalities were more common in the cases of papillary atrophy. Among the organic lesions found were atrophy of the gastric mucosa, traction diverticulum of the esophagus, hiatus hernia, diverticulum of the duodenum, polyposis of the sigmoid, and anorectal leucoplakia. The occurrence of functional and organic disturbances of the gastrointestinal tract was sufficiently frequent to indicate that the oral and lingual lesions were related to a generally deranged digestive physiology. Other common associated lesions were cheilosis and perlèche, and thick striated nails. Various types of anemia were occasionally observed.

The administration of large quantities of yeast to patients with papillary atrophy or oral leucoplakia was followed occasionally by a complete or partial remission of their lesions and oral symptoms. This further indicates a relationship between the lack of certain dietary factors and the appearance of such lesions. JOHN L. LINDQUIST, M.D.

**Tannenbaum, A.: The Genesis and Growth of Tumors. Effects of Caloric Restriction *per Se*.** *Cancer Research*, 1942, 2: 460.

In a previous communication, it was shown by the author that the restriction of food intake of experimental groups of mice resulted in the formation of far fewer tumors than were formed in the corresponding control groups which were fed *ad libitum*. Moreover, the tumors of the restricted animals appeared at a later time. This inhibition of tumor formation was obtained with all types of tumors studied: spontaneous tumors of the breast and lung, and carcinomas and sarcomas induced by a carcinogenic hydrocarbon. The diet given to the experimental groups was restricted in caloric value and correspondingly in all components, yet the underfed animals maintained their general health. They did not reveal any clinical manifestation of nutritional deficiencies, and lived longer than the controls. Deficiencies in vitamins and minerals are not the factors responsible for this observed inhibition of tumor formation for experiments in which the restricted diet was supplemented with vitamins and minerals to the approximate level present in the control diet resulted in the same inhibition. For these reasons, it was stated that the inhibition of tumor formation was "probably due to caloric restriction." The studies reported in this article indicate that caloric restriction *per se* is the principal factor in the observed inhibition of tumor formation.

The formation of the induced epithelial tumor, induced sarcoma, and spontaneous breast tumor of the mouse is definitely inhibited by a diet restricted in caloric content. Not only were these fewer tumors in the restricted groups, but the tumors appeared, on the average, at a later time than the tumors of the corresponding *ad libitum* groups. It is important to stress the excellent condition of the animals consuming the restricted diet.

The mice on the caloric-restricted diet outlived the controls. One might expect this result since more animals in the full-fed groups developed tumors and died. Therefore, the fact that the nontumor restricted animals have a longer life span than the nontumor controls is of greater significance and proves the importance of caloric restriction to longevity.

From the viewpoint of experimental cancer research, the results imply that any experimental procedure that produces secondarily a restricted food intake or assimilation may produce results that might be mistaken for a primary effect. For example, an experiment may be reported in which there is observed an inhibition of tumor formation.

The possibility that the experimental results have practical value with regard to human cancer has been discussed in a review of insurance statistics concerned with the relationship of body weight to cancer incidence. It is shown that persons of average weight or less are not as likely to develop cancer as those who are overweight. It follows that the avoidance of overweight through restriction of food intake may aid in the prevention of human cancer, or at least delay its onset. JOSEPH K. NARAT, M.D.

**Tannenbaum, A.: The Genesis and Growth of Tumors. Effects of a High-Fat Diet.** *Cancer Research*, 1942, 2: 468.

This communication is a report of the effects of dietary fat on both the genesis and growth of tumors. The tumors utilized were the spontaneous breast tumor, induced skin tumor, induced sarcoma, and primary lung tumor of the mouse.

The most striking result of these investigations is the diversity of effects produced by a high-fat diet: (a) the incidence of the spontaneous breast carcinoma was significantly increased; (b) the incidence of the induced skin tumor was increased; (c) the incidence of the primary lung tumor was unaffected; and (d) the incidence of the induced sarcoma was unaffected or actually inhibited.

A high-fat diet not only produced a definite increase in the incidence of spontaneous breast and induced skin tumors, but also shortened the mean time of appearance of these tumors. The mean growth rate of sarcomas arising in the group with the high-fat diet was not significantly different from that of sarcomas arising in the control group.

A twofold action of a high-fat diet (solvent action and cocarcinogenic action) is postulated to explain the diverse effects on tumor formation. Under certain conditions the solvent action may concentrate the carcinogen in a particular area, while under other conditions it may remove the carcinogen, as from a site of injection. Cocarcinogenic action may be considered to be a metabolic stimulation of carcinogenesis. JOSEPH K. NARAT, M.D.

**Minor, A. H., and Ramirez, M. A.: The Utilization of Vitamin C by Cancer Patients.** *Cancer Research*, 1942, 2: 509.

Vitamin C occurs in high concentration in all actively growing parts of the higher plants, in the key endocrine organs, and in young animal and human tissues. A direct relationship exists between the functional activity of the corpus luteum and its content of Vitamin C. An adequate amount of this substance seems essential for normal wound healing. Vitamin C thus appears to be associated with the growth and function of plant and animal tissues.

It seemed possible that the increased metabolic activity of carcinomatous tissue might be associated with an increased local utilization of Vitamin C which, if of sufficient magnitude, would cause a detectable decrease in the urinary excretion of this substance by cancer patients. The authors' study was undertaken in an endeavor to investigate the validity of this hypothesis. It consists in a quantitative estimation of the utilization of Vitamin C by cancer patients, with suitable controls.

Thirteen patients were studied for periods of from nine to sixteen days each; 5 had metastatic cancer, 1 had localized cancer, and 7 were controls. All patients were ambulant adult males. A fruit-free, vegetable-free diet was given. Ammonium chloride (4 gm.) was given daily to ensure an acid urine and to enhance the recovery of Vitamin C. Alkali administration was forbidden.

Vitamin C (500 mgm.) was injected daily, subcutaneously. Parenteral administration was selected in preference to oral administration because of partial loss of the vitamin in the digestive tract by destruction, neutralization, or malabsorption. The subcutaneous route permitted slow absorption, and thus minimized the plasma elevation and the consequent overflow through the kidneys which occurs when large doses are given intravenously, and because of the size of the dose it was more convenient than the intramuscular route.

The daily utilization of Vitamin C in the control group varied from 42 to 88 mgm., and averaged 67 mgm. The daily utilization of Vitamin C in the patient with localized cancer was 68 mgm., a value falling well within the range of the control group. The daily utilization of Vitamin C in the metastatic cancer group varied from 101 to 161 mgm., and averaged 125 mgm. This group, therefore, was found to utilize approximately twice as much Vitamin C as did the control group.

Considerable evidence has accumulated in support of the concept that ascorbic acid may function in animal tissues as a respiratory enzyme. Moreover, it was found that this action was inhibited by a number of carcinogenic agents, the degree of inhibition tending to vary directly with the carcinogenicity of the agent. All of the carcinogens studied exerted this inhibitory effect.

A possible explanation for the finding of an increased utilization of Vitamin C by patients with metastatic cancer is therefore apparent. If the presence of an active carcinogen in cancer patients is postulated, an interference with cellular respiration by this agent might cause a compensatory accumulation of ascorbic acid in the affected tissues and thus diminish the excretion of Vitamin C.

JOSEPH K. NARAT, M.D

## SURGICAL PATHOLOGY AND DIAGNOSIS

**Paletta, F. X., and Max, P. F.: The Influence of Estradiol Benzoate on Epidermal Methylcholanthrene Carcinogenesis.** *J. Nat. Cancer Inst.*, 1942, 2: 577.

"The application of a-estradiol benzoate accelerated the transformation of benign tumors into malignant tumors in methylcholanthrene skin carcinogenesis in virgin female mice of a Swiss inbred stock.

"Estrogens shortened the induction period for the appearance of carcinomas in the estrogenized mice as compared with the controls."

WALTER H. NADLER, M.D.

## EXPERIMENTAL SURGERY

**Tekhodeev, S. M.: The Mechanism Involved in the Production of Pulmonary Lesions Due to Contusions Caused by Explosions.** *Chirurgia*, 1941, No. 4, p. 43.

Continuing a series of studies partly reported a few years ago, the author in this article reports on animal experiments done with the purpose of establishing the mechanism involved in the production of pulmonary lesions following contusions of the chest. These experiments were done on 54 dogs which were exposed to explosions severe enough to cause damage and yet not severe enough to cause the death of the animals. In 6 dogs the effects of blunt trauma were studied.

Shortly after the exposure to trauma, aerial or mechanical, the dogs were sacrificed and the organs were examined macroscopically and microscopically. The outstanding pathological feature in all cases consisted in the presence of more or less pronounced and more or less widely distributed hemorrhages in almost all of the organs and subcutaneous tissue.

The most frequent site of hemorrhage was the lungs; as a matter of fact, in 95.2 per cent of all the lung specimens studied hemorrhages could be seen, whereas the frequency of hemorrhage in other organs was as follows:

| Organ Involved | Per cent of Cases |
|---|---|
| Brain | 4.8 |
| Stomach | 33.4 |
| Intestines | 14.3 |
| Liver | 9.5 |
| Heart and pericardium | 28.5 |
| Subcutaneous tissue | 52.5 |

The frequency of occurrence of pulmonary hemorrhages, observed macroscopically, following exposure of the individual to explosions had already been noted in 1914 by Ruske, but, according to the author,

so far Ruske's observations have not been confirmed experimentally by anybody.

On the basis of these observations the author asserts that the clinical symptoms observed after explosions are not due to functional disorders caused by the aerial trauma, but have a definite organic basis. In 58.3 per cent of the material studied the diagnosis of pulmonary hemorrhage due to contusions could be made roentgenologically. As far as the mechanism of production of these hemorrhages is concerned, Tekhodeev accepts partly the conception of other scientists, who assert that these hemorrhages are the result of direct traumatisms of the chest walls transmitted by the ribs to the lung parenchyma.

Such changes as rupture of the visceral pleura, massive hemorrhages, partial or total tear of the lung or parts thereof, or striae filled with blood and situated in the midst of destroyed lung tissue are due to the direct action of the trauma. Striae directly underlying the ribs, although observed quite frequently, were not always present, because if the autopsy was not performed fast enough the blood had time to infiltrate the lung tissue and to produce a hemorrhage resembling an infarction.

However, the factor entering into the production of pulmonary lesions following exposure to explosions so far overlooked is the irritation of the vascular system of the lungs and that of the nerves supplying the pulmonary vessels. Trauma of the chest, mechanical or aerial, causes disturbance of the hemodynamics by irritation of the aforenamed structures; this is characterized first by a short phase of anemia and followed later by dilatation of the vessels and diapedesis. The hemorrhage thus resulting is followed by filling of the alveoli and subsequent rupture of their walls. These vascular changes may occur in any part of the lung, including the hili. To prove this observation the author anesthetized the pleura of several dogs with 10 per cent cocaine. In these cases only slight local hemorrhages or none at all occurred and no general reactions were observed.

The author considers the lung a neuromuscular and neurovascular organ, in which, following a trauma, the arterial pressure falls and the venous pressure rises which produces stasis and diapedesis. The occurrence of emphysema following explosions is explained by the author, therefore, as being due to 2 mechanisms: (1) rupture of the walls of the alveoli due to pulmonary hemorrhages, and (2) rarefaction of the air in the second phase of the explosion. The fact that the upper part of the lungs is traumatized less frequently than the lower part is explained by the author by the protection offered to the chest walls by the muscles. GEORGE SIMMONS, M.D.

**Sylvén, B.: The Occurrence of High Molecular Sulfuric-Acid Esters in Granulation Tissue and in Epithelial Regeneration** (Ueber das Vorkommen von hochmolekularen Esterschwefelsaueren im Granulationsgewebe und bei der Epithelregeneration). *Acta chir. scand.*, 1941, 86: Supp. 66.

In a lengthy monograph the author discusses the results of his studies on the occurrence of high molecular sulfuric-acid esters in granulation tissue and in epithelial regeneration.

He first discusses the chemical properties and the occurrence of high molecular sulfuric-acid esters. By these substances are meant organic combinations of bases and sulfuric acid with the following schematic formula: $R - (O - SO_2 - OH)_n$. It is evident from this formula that there may be monoesters and polyesters of sulfuric acid. In the following only the high molecular mono- and poly-sulfuric-acid esters occurring in the human organism are considered. These substances are mucoproteins, heparin, and others. They may be identified by means of basic metachromatic aniline dyes. As a result they are called chromotropic substances. By means of these dyes they can be studied in the various tissues. They occur in free and in combined form and the old terms of "slime" and "mucin" must give way to "free" and "combined chromotropic substances."

The author defines what he means by the term "metachromasia" insofar as it pertains to metachromatic aniline dyes. He discusses the different dyes employed and gives a historical review of the theories regarding the cause of the metachromatic color reaction, and especially of Lison's investigations, which form the basis of the modern conception regarding the method of action of these metachromatic dye substances. He also discusses in detail his own method, with special reference to the value of the employed method of fixation. He points to the possibility of a quantitative estimation of the free and combined chromotropic substances present. He points to the greater sensitivity of his method as compared with that of the Mayer mucicarmin method.

In the third chapter the author discusses the occurrence of free chromotropic substances in connective tissue during the embryonal and adult stages. He emphasizes the newer methods of investigation. A short report is made also of these substances in the musculature of the body, in the epithelium, and in the skin. Various theories regarding the occurrence of these substances in the tissues of embryonal and adult life are discussed. He points out that the theory that the individual cells form the chromotropic substance (secretion theory) is still unproved.

In Chapter IV the author discusses the combined chromotropic substance in normal tissues of the embryonal and adult organisms. This is bound morphologically only to one type of body cell, and under normal conditions there is only one such cell occurring in the connective tissue of the body, the Ehrlich "mast cell." He discusses the morphology, occurrence, and function of the mast cells. Regarding their general biological function in the organism he points out that the function in relation to the blood is now pretty well known. Whether the mast cells perform a biological function in connective tissue in any of the processes which take place there is not known. The theory brought forth by Staemmler regarding the function of the mast cells in connective tissue is criticized; according to the views of most authors it has not been proved.

In the next 3 chapters the author discusses wound healing and the function played by the mast cells. His own experiments have shown that, on the one hand, before the appearance of free chromotropic substance within the growing mesenchymal cells there is at the same place an increase in the number of mast cells, and, on the other hand, with the appearance of free chromotropic substance in the cells there is a decided decrease in the number of mast cells in the region and likewise a decrease in the number of granules in the remaining mast cells. When the adult connective tissue is the seat of inflammation of an exudative nature which later leads to degeneration and necrosis of the connective tissue, no free chromotropic substance is found there and the number of mast cells is less than normal. In such unspecific inflammatory changes, however, in which a reparative connective-tissue growth is taking place especially in the form of low differentiated mesenchymal elements, these elements show an abundance of free chromotropic substance in their cytoplasm during the stage of growth. The occurrence of free chromotropic substance does not accompany any of the degenerative changes and there is no evidence to support the older theories of mucoid degeneration. From these findings which are supported by experiments, it is evident that the appearance of free chromotropic substance and the occurrence of granulation tissue with characteristic changes are associated, especially as pertains to the number of changes, the granule content, and the regional localization. Although definite proof is not available the author believes that the free chromotropic substance occurs through the shedding of the granules from the mast cells. This explanation is temporarily the only one which corresponds correctly with the observations made. The author's investigations, however, bring no support to the older secretion theory.

The author presents his investigations of the older views existing in the pathologicoanatomical literature regarding the so-called slime and mucin and similar substances in the connective tissue of the adult organism in various biological conditions. He points out that these phenomena have been considered purely degenerative in nature and no biological function has been ascribed to any of them which occur in the realm of connective-tissue proliferation or degeneration.

The author has carried out experiments on wound healing per primam on the rat and, on the other hand, on pathologicoanatomical material in the human being in which unspecific and specific inflammatory changes were present. With a dependable metachromatic staining technique he investigated the occurrence of so-called free chromotropic substance (high molecular sulfuric-acid esters) and of mast cells. Especial interest was shown in the reparative new formation of connective tissue and the earliest stage thereof.

The author's investigations show that high molecular sulfuric-acid esters are constant and abundant in the connective tissue of the adult organism only in such biological conditions in which new formation of connective tissue occurs, i.e., in little differentiated growing granulation tissue. The morphological picture of these sulfuric-acid esters is discussed and an attempt is made to determine their origin.

The author then discusses the occurrence of chromotropic substance in free and in combined form in regeneration of pavement epithelium. He describes how the skin of the human being in certain areas shows abnormal structure because free chromotropic substance is found in moderate amount in the papillary layer in conjunction with a moderate degree of hyperkeratosis of the epidermis. To investigate the conditions in exaggerated epithelial regeneration certain experiments were undertaken on rats. These showed that free chromotropic substance appeared during the period of marked epithelial regeneration in the basal cell layers of the epidermis. In addition there was a loss of granules at the same time in the mast cells and an increased amount of mast cells poor in granules along the border between the connective tissue and pavement epithelium. The author believes it plausible that the free chromotropic substance occurs through the loss of granules by the mast cells.

It therefore appears that in experimentally induced epithelial regeneration the same phenomena take place as occur during normally rapid regeneration of the epidermis and during the growth of hair. The phenomena are similar insofar that free chromotropic substance appears to occur in the neighborhood of growing epithelium.

In conclusion, the author has shown that not the slightest morphological evidence was obtained for the older viewpoint that these free chromotropic substances are the result of degenerative changes occurring in the connective tissue.

L. A. JUHNKE, M.D.

## HOSPITALS; MEDICAL EDUCATION AND HISTORY

**Thomson, Sir St. C.: A House Surgeon's Memories of Lister.** *Edinburgh M. J.*, 1942, 49: 313.

It is not a century since Velpeau said that "A pinprick was a door for death." The heavy death toll paid by parturient women was a tragic remembrance, and a surgeon of those days made the pronouncement, "an abdominal operation should be classed among the methods of the executioner." Septicemia, pyemia, erysipelas, tetanus, and hospital gangrene were scarcely ever absent from any large hospital in the world of that day. The surgical wards everywhere smelled of the stench of putrefying wounds. The lay literature referred to the "hospital smell," and accepted it as an inevitable concomitant of a hospital. Such was the condition of things prior to the time of Lister. These horrors had haunted him from his student days. He had thought sadly and deeply upon their cause and the prevention of wound infection.

Born of prosperous parents on April 5, 1827, Joseph Lister inherited from his father a love of learning and science, and ever had the means and leisure necessary for a thorough training in them. He graduated from the University of London, and won all the scholarships and medals offered to students of his day. It consequently was no surprise when he became Professor in the University of Glasgow and Edinburgh. In 1853 he became associated with Syme, one of the leading surgeons of Europe, whose eldest daughter he later married. It was while in Glasgow that Lister solved the age-long mystery of antisepsis. At Edinburgh, he worked in the wards of the Old Infirmary in High School Yards, confirming the principles on which his wound treatment was based and developing the technique of its practice. Soon surgeons from all over the world were coming to see "wounds free from pus, the serous discharge free from smell, to listen to the 'Chief'," as Lister was called, "and to be converted."

In 1877, Lister left Edinburgh for London, his native city, where a cold reception was given to him by members of his profession. "The antiseptic doctrine had been accepted in every part of the world except London, where alone it had made little way," recalls his biographer. "The colossal apathy, the monstrous inertia to the force of new ideas; the inconceivable indifference shown by students and surgeons of London" was the manner in which a devoted pupil described the situation in that day. The opposition to the gospel of antisepsis was astonishing—almost unbelievable. London was slow to accept the new principles. Ten years later a younger generation had come along, and "it is a question if any change in human affairs or any disturbance of human creeds has ever been so striking, thorough and unexpected" as the change of the whole atmosphere of surgery in London. "Asepsis and antisepsis" are the discussion topics of the times. In 1897, Lister was made a peer, the first peerage ever conferred on a surgeon.

The outstanding trait of this great man's character was his invariable gentleness and sympathy with the humblest and roughest of his hospital patients. He seldom referred to a patient as a "case," but introduced his remarks with such kindly terms as "this poor fellow," or "this good woman," or "this little child." His touch in manipulation was delicate, and he taught the importance of avoiding any roughness or bruising of the tissues. He was a slow, careful, and deliberate operator. His bearing was dignified, and his manner invariably courteous, but with the natural restraint of a serious and sincere soul.

Before his death on February 10, 1912, in his eighty-fifth year, Lister had received most of the honors given by a grateful people. He would have been buried in Westminster Abbey had he not left instructions to be buried in the same grave as his wife in West Hampstead Cemetery. He was afforded a public funeral in the Abbey, and a lifelike memorial medallion of his bust is placed there near those of the great scientists, Darwin, Stokes, Adams, and Watt.

Lister, says the essayist, has created anew the ancient art of healing, and has done more for the relief of bodily suffering, the security of life, the prevention of anxiety, the conversion of fear into joy, than any one man who has trod the earth. No longer need a pinprick be the door of death, nor the man lying on the operating table be exposed to more chances of certain death" than the English soldiers on the field of Waterloo."

STEPHEN A. ZIEMAN, M.D.